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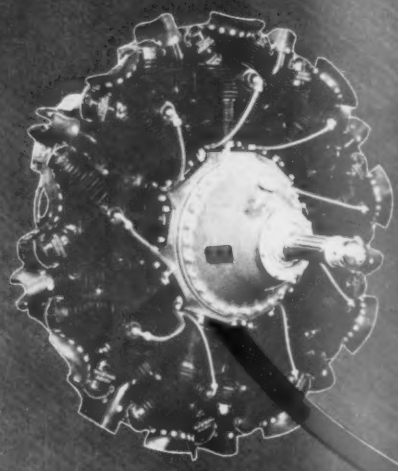

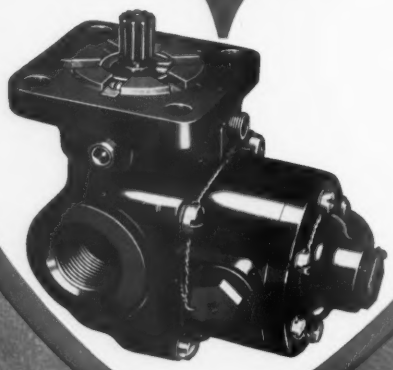

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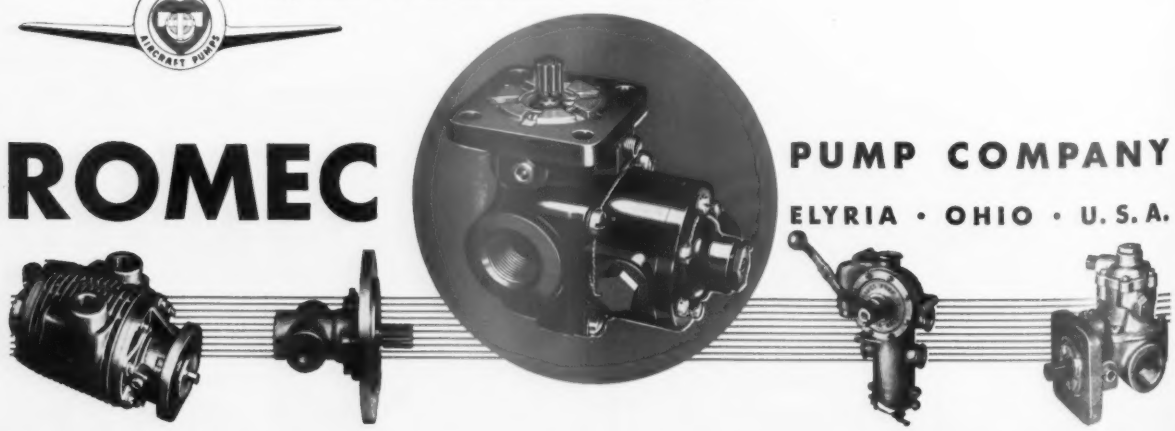

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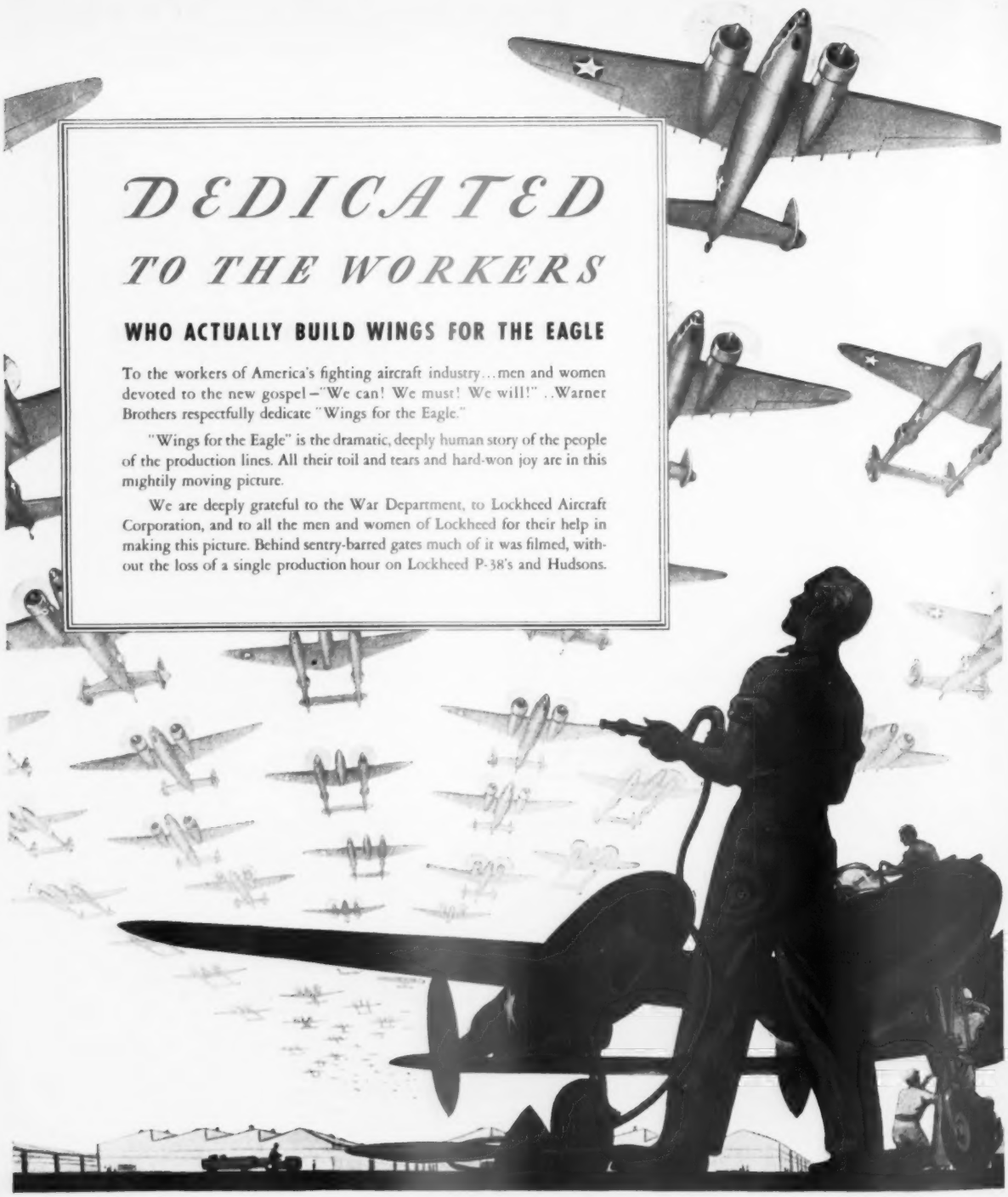

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Aircraft Engine Installation

E. C. SULZMAN*

Wright Aeronautical Corporation

Introduction

The accelerated activity in the aircraft field during the past few years has placed a heavy burden on the power-plant installation designer. He has been called upon to install power plants equivalent in horsepower to that of our largest locomotives. In making this power-plant installation, he is obliged to confine the unit to a minimum of space; however, it still must be easily accessible for servicing. It must be as light in weight as possible but sturdy enough for the rigorous use for which the aircraft is intended. Besides these requirements, he finds his installation may govern the entire airplane design and its aerodynamic characteristics. He also finds that for a satisfactory installation each one of the components of the power plant—cooling system, oil system, fuel system, induction system, exhaust system, etc.—requires careful engineering investigation to insure proper engine operation.

Faced with a complex problem such as this, the installation designer usually feels that the engine manufacturer does not take full cognizance of these problems. It is admitted that all the offending conditions are not always anticipated; however, it can be assured that continual effort is put on this phase of the engine design and, through close engineering coordination with the aircraft engineers, installation difficulties will be kept to a minimum.

Cylinder Cooling

The problem of cylinder cooling is sufficiently complex to require confining a paper to it alone. Rather than consider cowling design problems, therefore, this discussion will be confined to a study of the cylinder cooling requirements and steps taken to rationalize them.

The demand for maximum airplane performance has made it necessary to control closely the cooling airflow across the engine. To accomplish this, the installation designer requires adequate design data from the engine designer to permit him to make a rational analysis of the engine cooling requirements. To comply with this requirement, a cooling correlation chart was prepared (Fig. 1.).

Presented at the Power Plants Session, Tenth Annual Meeting, I.Ae.S., New York, January 28, 1942.

* Assistant Chief Field Engineer.

Fig. 1 illustrates the effect on cylinder cooling of such major variables as b.hp. per cu.in. of displacement, cooling air temperature, cooling air density, specific fuel consumption, and cooling air pressure drop across the cylinders.

From this chart the baffle pressure requirements of the engine can be determined and, knowing the baffle passage area, the cooling airflow requirement cu. ft. per min. and, consequently, the cooling drag in terms of hp. can be determined. Using this method, Fig. 2 has been prepared to illustrate the cooling requirements of a typical air-cooled aircraft engine. It is quite obvious that the engine cooling requirements do not follow the line of available baffle drop. This condition is unfortunate, since it eliminates the possibility of using cowls with fixed exit slots. The peculiar shape of this cooling requirement line is caused by the combination of allowable cylinder head temperatures and the fuel consumption guarantees.

Cowl Exit Effect

Under present procedures of engine procurement, the establishment of ratings and fuel consumption limits makes it necessary to fix the cylinder head temperature limits at such values that the critical cooling condition occurs at cruising power output. Thus a cowl designed with a fixed slot for the most critical cooling condition—cruising—will provide excess cooling at rated and military power. The cowl designed with fixed slot, necessary for cooling at cruising power, would overcool the engine at military power by 70 cooling hp. To overcome this cooling drag penalty, the aircraft manufacturer resorts to controllable cowl exits, and by using two positions of the cowl flaps he can reduce this excess cooling hp. to 30. This type of cowl then has one setting for high speed—closed—for rated or military power, and another for cruising output—partially open. A third position is ordinarily also required—full open—for ground and climb cooling.

Past practice limited use of the flaps for climb operation only. All level flight operations were conducted with the cowl flaps in the closed position. Realizing the cooling penalty this requirement imposed during high-speed level flight, it is now considered permissible to position the cowl flap for both

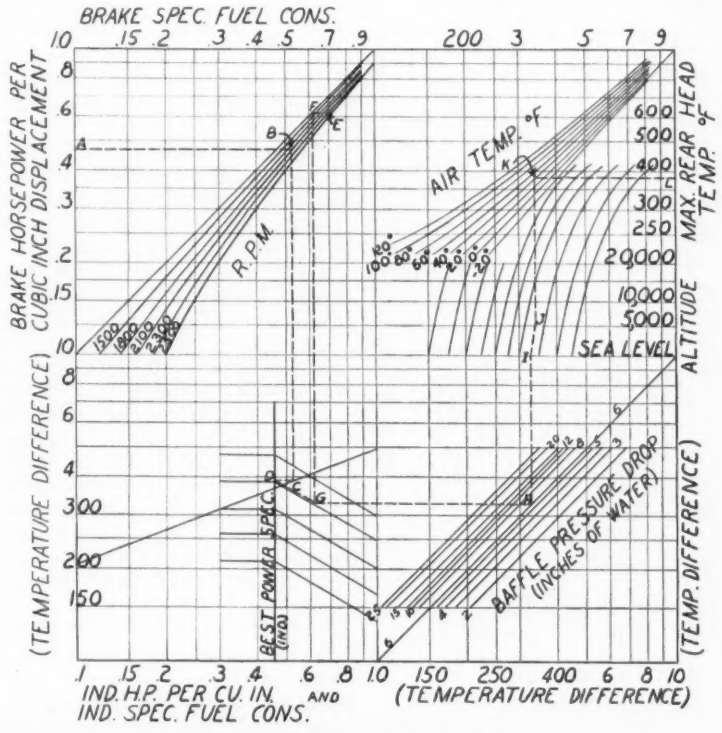


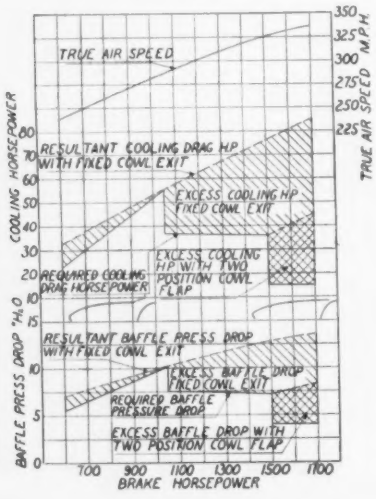
Fig. 1. Cooling requirement data.

cruising and high-speed flight. It is expected that automatic cowl flap control will eventually overcome the need for this manual control.

"Hot Day" Cooling Requirements

Fig. 2 represents cooling requirements for the "hot day." This "hot day" is established to represent a maximum warm weather condition. Under this condition, cooling within the maximum temperature limits is required. Under normal circumstances, the airplane encounters the "hot day" temperature only during short periods of time. Since it is a more or less abnormal condition to test for and since all engine and airplane performance figures are based on the standard 60°F. day, it now appears reasonable to conduct test demonstrations with the engine cooling corrected not to the "hot day" but to the standard 60°F. day. The interpretation placed on this procedure is that sufficient cooling must be provided to cool the engine on the "hot day," and the cowl flap positions are established for this condition; but for airplane performance demonstration only, the cowl flaps are adjusted to give only the necessary cooling to meet the maximum temperature limits on the standard 60°F. day.

Figs. 1 and 2 illustrate the importance of establishing cylinder temperature and fuel consumption limits at such values that the baffle pressure-drop cooling requirements of the engine fit more closely to the line of available baffle pressure drop with fixed cowl position. Realizing the importance of this item, the desirability of increasing the cylinder temperature limits for the critical cooling conditions becomes obvious. To accomplish this, the present practice of establishing guaranteed fuel consumption at 75 per cent of rated power may require serious reconsideration, since it requires specifying minimum fuel consumption values at the power where the cooling is most critical. A thorough study of the engine cooling problem is in progress at present, and it is expected that procedures will be established whereby the engine cooling requirements can be made to fit more closely the cooling air pressure drop available with fixed cowl position.


TRUE AIR SPEED
TRUE AIR SPEED M.P.H.
COOLING HORSEPOWER
RESULTANT COOLING DRAG H.P. WITH FIXED COWL EXIT
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EXCESS COOLING H.P. WITH TWO POSITION COWL FLAP
REQUIRED COOLING DRAG HORSEPOWER
BAFFLE PRESS DROP "H2O
RESULTANT BAFFLE PRESS DROP WITH FIXED COWL EXIT
EXCESS BAFFLE DROP FIXED COWL EXIT
REQUIRED BAFFLE PRESSURE DROP
EXCESS BAFFLE DROP WITH TWO POSITION COWL FLAP
BRAKE HORSEPOWER

FIG. 2.

OIL COOLING AND THE OIL SYSTEM

Before discussing the oil cooling problem, it might be well to consider the following facts regarding heat rejection to the oil in a modern hypothetic radial air-cooled engine.

Take-off, b.hp.	1,700
Normal rated, b.hp.	1,500
Heat rejection to the oil at rated output	3,000 B.t.u. per min.

3,000 B.t.u. per min. = 70.6 hp.
Friction hp. = approximately 10% of b.hp. = 150 hp.
Heat rejection to the oil = (70.6/150) × 100 = 47.0% of friction hp. = 4.7% of engine b.hp.

These figures show that the heat rejection to the oil is a very small percentage of the engine b.hp. They also show that only about 50 per cent of the total heat put into the oil, due to friction horsepower, comes out of the engine at the oil-out port. The other 50 per cent of the heat rejection to the oil is dissipated through the engine crankcases and cylinder walls. From the cooling standpoint, this is fortunate, but from the heat rejection control standpoint this presents a difficult problem. It introduces an installation factor over which the engine manufacturer has no control.

In order to analyze properly the oil cooling requirement, the aircraft manufacturer continually solicits the engine manufacturer for specific heat rejection data, and he frowns upon any wide tolerances that may be applied. Since the cooling air variable and installation factor have control over approximately 50 per cent of the total heat rejection to the oil, the engine manufacturer, when asked to name a top heat rejection figure, naturally resorts to a figure with a comfortable margin, if possible. To complicate further the problem of releasing heat rejection data, the engine manufacturer finds that the oil flow is just as variable, since its control is governed by complex tolerances on bearing fits, flow passages, and other related conditions.

Heat Rejection and Oil Flow Control

An extensive study of the heat rejection and oil flow control problem was recently conducted on a large series of engines and the following conclusion were reached:

(1) The variables present in engine design are such that a variation of not less than 30 per cent from the maximum may be expected in oil flow of production engines during controlled test conditions of horsepower output, r.p.m., oil inlet temperature, oil pressure, and carburetor air temperature.

(2) The variables present in engine design are such that a variation of not less than 60 per cent from the maximum may be expected in oil heat rejection of production engines during control test conditions of horsepower output, r.p.m., oil inlet temperature, oil pressure, and carburetor air temperature.

(3) The variation in heat rejection which may be expected between engines can be partially evaluated only after considerable production experience has been obtained on a specific model engine. The variation or the average values may be changed by modifications in the engine construction which are found necessary as a result of service experience.

(4) Any guarantees on heat rejection to the oil and oil flows established in the engine specification prior to actual production experience must obviously be based solely on past experience and, unless serious production delays and expense are to follow, must provide sufficient tolerance to allow for variables beyond the reasonable and practical control of the engine manufacturer.

This complex condition regarding control of heat rejection and oil flow naturally offers no solution to the aircraft manufacturers' problem of supplying adequate oil cooling. The above statements are offered simply to justify the reticent attitude of the engine manufacturer when he is called upon to set up guarantees or to publish heat rejection and oil flow data. This problem is not at all insurmountable, however, as evidenced by the large number of satisfactorily cooled installations now in service.

To maintain reasonable control of production engines, the engine manufacturer sets up production limits on heat rejection and oil flow that are in accordance with the maximum limits given in the engine specification. Each production engine is therefore checked under reasonably controlled conditions to insure that it does not exceed these maximum limits. An engine beyond limits is immediately pulled from the test block and disassembled for inspection to determine the cause for any excess flow or heat rejection. An engine that exceeds the production limits cannot be released for shipment.

Engines received at the aircraft manufacturer's plant, therefore, although within the maximum limits given in the engine specification, may vary within the limits mentioned before. This would not be too serious if the installa-

tion designer could be assured that he was testing an engine having maximum conditions of flow and heat rejection. Unfortunately, this is usually an impossible arrangement because his testing is usually conducted on an experimental model, because production experience on the model tested has not been established, or because it may be impossible to build up the flight test engine to have the maximum flow and heat rejection conditions. It is possible, however, to provide flow and heat rejection data on the flight test engine, and on the basis of cooling results obtained on this engine the effectiveness of the airplane cooling system as installed can be evaluated. Then, by utilizing the oil cooler performance data, it can be established whether or not the cooling system is adequate to handle the production engine with maximum flow and heat rejection conditions. This practice has not been employed in the past, but after full realization of the problem it is felt that the aircraft manufacturer can use this procedure to provide oil cooling with adequate margin to handle engines with normal production variations and also to provide sufficient margin for engine changes affecting oil flow and heat rejection found necessary from service operation.

Providing overcooling, in the past, presented installation difficulties not only from the standpoint of space and drag limitations but also from the standpoint of temperature control. Oil coolers were subject to severe congealing and poor regulation. Fortunately, the oil cooler manufacturer came to the rescue by improving the cooler and regulating valve design to overcome these unsatisfactory conditions. This problem of providing ample margin of cooling should no longer be objectionable from this standpoint.

High-Altitude Operations

High-altitude operations have recently indicated another oil system difficulty that must be corrected. This difficulty indicates itself in the form of loss in oil pressure, oil pressure fluctuation, or foaming in the oil tank. It is believed that these objectionable conditions are caused by the air entrained in the oil feed to the engine. This condition becomes more evident on the high output engines with high oil flows.

Oil removed from the engine sump by the scavenge gears is aerated to a large extent because of the nature of the engine scavenge system. Passing through the engine to the sump, the oil picks up air. The scavenge pump gears, larger in capacity than the pressure pump gears, cause the scavenge oil return consisting of alternate slugs of aerated oil and air to be fed into the airplane oil tank. This return oil must be deaerated before it is fed back into the main supply.

Recently, a rig test was conducted on a typical airplane oil system and some alarming results were obtained. A diagram of this test setup is shown in Fig. 3. The installation tested gave trouble in the airplane in the nature of fall off in oil pressure with increase in altitude. This same oil system, when tested on the full-scale engine test rig, showed violent engine oil pressure fluctuation when operated under simulated flight conditions. The violent fluctuations in pressure appeared on the test stand pressure gauge, which was a large-scale sensitive type with no damping in the pressure line. An aircraft-type pressure gauge with a No. 60 drill restriction at the connection fitting was also installed in parallel with the sensitive test stand gauge and, while the sensitive gauge was violently fluctuating, the airplane type gauge simply fell off in pressure 5 to 10 lbs. per sq.in. A sight glass was put in the engine oil-in line, and it was observed that whenever operating conditions were such as to cause air in the engine supply line, as observed through the sight glass, the sensitive gauge would fluctuate and the airplane gauge would simply fall off in pressure. The greater the quantities of air entrained in the oil-in supply, the more violent would be the fluctuations on the sensitive gauge and the greater the pressure drop on the aircraft type gauge.

Separating Entrained Air

The particular oil system tested incorporated a tilted warm-up compartment in the tank, which apparently did little to separate out the entrained air from the scavenge oil. As an experiment, the warm-up compartment was moved. This then allowed the oil return into the tank to tunnel directly into the tank oil supply. Experience with test-stand oil systems has shown that oil return, fed directly into the tank supply without first being fanned or deflected, will carry its entrained air into the main supply and, when in the large body of oil, the air will not separate out. It is, therefore, carried back into the engine, resulting in pressure fluctuations. This was the case when the warm-up compartment was removed.

The next step in this experimental setup was to install a "tee" fitting where the scavenge oil returned to the tank. This fitting thus caused the return oil to separate into two streams as it entered the inside of the tank. A successful result was obtained. The same operating condition which had before caused oil pressure fluctuation now was eliminated since the sight glass revealed clear oil (free from entrained air) was being fed to the engine.

Investigation has also been made on the use of centrifugal air separators. The type that appears to have considerable merit is one that circulates the re-

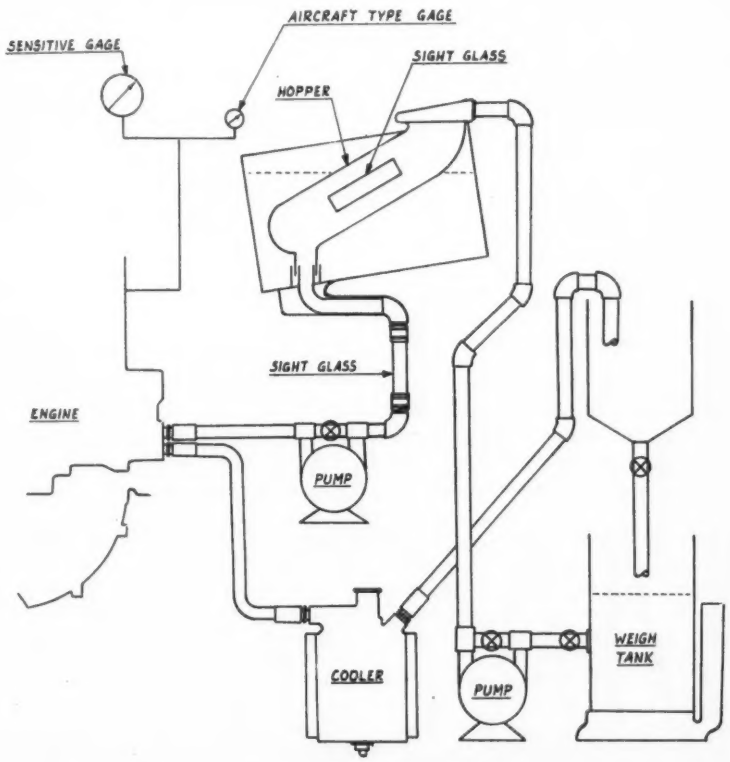

FIG. 3. Oil system test rig.

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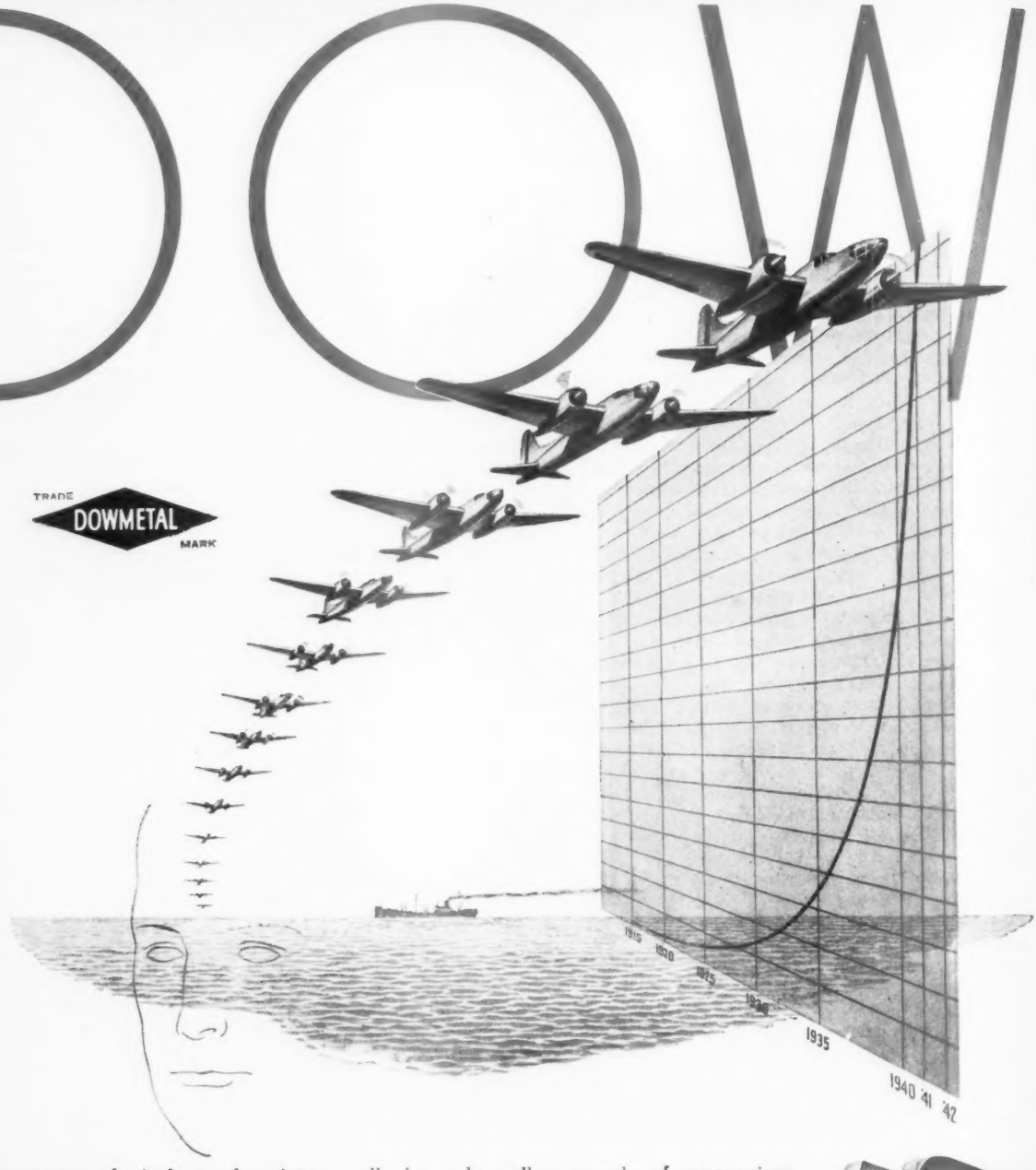

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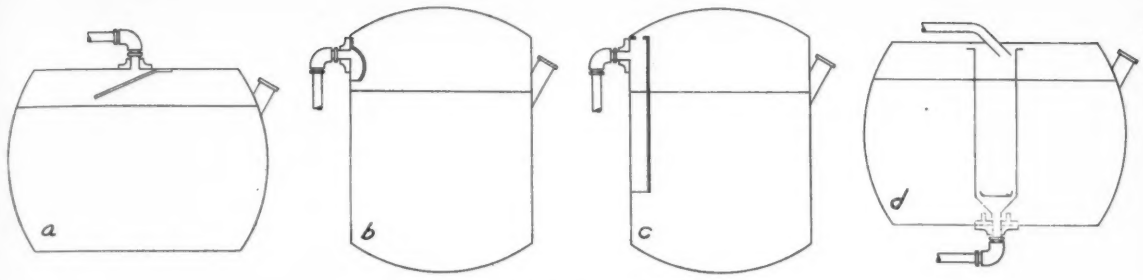

FIG. 4. Typical oil tank baffles.

turn oil to the tank through a tubing coil. The inside wall of the coil has small holes out of which the air escapes. The coil causes a centrifugal loading on the oil which squeezes out the air. The air, being the lighter medium, passes into the low-pressure area inside the tank by escaping out of the holes on the inner walls of the coil. The coil must naturally be kept above the oil supply. It is felt that this method is a worthwhile expedient for overcoming severe cases of entrained air.

Oil Tank Baffles

Other expedients employed in the oil tank are shown in Fig. 4. Fig. 4a shows a simple baffle plate onto which the oil returned to the tank is directed. This plate is shaped so that the oil fans out, thus allowing the entrained air bubbles to leave the oil. Fig. 4b shows a special fitting that covers the oil feed into the tank. This fitting fans the oil down the tank side wall. A simple half-circle shield open at the top end to allow the air to escape is shown in Fig. 4c. This shield extends below the tank oil level to prevent splashing. Fig. 4d shows a baffle plate at the bottom of a warm-up compartment. The purpose of this baffle is to prevent occurrence of a vortex allowing air to be drawn into the engine oil feed line. This feature has been extremely successful.

It is felt that the importance of preventing air entrained in the engine oil-in supply cannot be overstressed. It becomes a more pronounced problem the greater the engine oil flow and the higher the operating altitudes. It is believed that all the aircraft manufacturers are conscious of this problem and are taking steps of some kind to overcome it.

Oil Supply During Maneuvers

An additional oil system problem that has recently been overcome is that of maintaining oil supply to the engine during violent airplane maneuvers. The most critical conditions appear during a negative acceleration of the airplane, such as obtained in a push-over entry into a dive. In such a flight condition, the oil supply is thrown to the top of the tank, allowing the engine feed line to uncover. This results in loss of oil supply to the engine just when it is needed most for the overspeed dive.

Fig. 5 shows a tank valve design that has given satisfactory flight results. This valve is simply a gravity loaded valve that slides up when the gravity load is upward and closes the normal tank outlet ports on the standpipe. Under negative gravity load conditions, the engine is fed oil from the top of the standpipe. Extensive dive testing has been conducted with this valve, and under no condition was a loss in oil pressure experienced. This valve design lends itself to easy application in most any tank design, and no complicated parts are needed in construction.

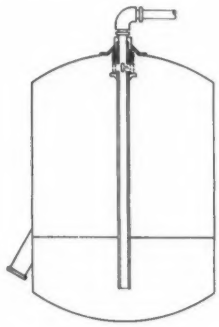

FIG. 5. Oil tank valve for diving provision.

Another recent oil system problem has been engine scavenge difficulty experienced at high altitude. This condition is caused by inability of the scavenge pump to lift the oil from the engine sump at the low absolute atmospheric pressure conditions obtained at high altitudes. The solution to this problem appears to be the use of sump pumps—i.e., an engine-driven pump built directly in the lowest portion of the sump so that its inlet is always drowned. This sump arrangement is being applied to new engine designs. As an expedient on existing engines with the pumps mounted external from the sump, the oil passages are being enlarged and cleaned up or the use of large external lines from sump to pump is being employed.

FUEL SYSTEM

The advent of automatic carburetion has introduced a requirement for close control of the fuel pressure at the carburetor inlet within specified limits. This requirement for close control of the pressure, while troublesome, is further aggravated by the demand for high fuel flows at high altitudes. These fuel system conditions have led to emphasis being placed on the elimination of vapor formation in the fuel, since a system subject to vapor formation will upset any method of fuel pressure and supply control.

The steps taken to eliminate or prevent formation of vapor are as follows:

Vapor Separators

A vapor separator has been developed which has been used successfully on a number of aircraft. It consists of a tank of about 1 qt. capacity incorporating a float actuated vent valve in the top of the tank. This vent is piped to a sylphon actuated relief valve that is set for a pressure 1 or 2 lbs. per sq.in. lower than engine fuel pressure. This setting is established to avoid violent fluctuations in fuel pressure when the vent opens. With this relief valve setting, the fuel will only fluctuate 1 or 2 lbs.

This vapor separator is installed in the fuel line between the engine-driven fuel pump and the carburetor. For accurate fuel flowmeter readings, it should be installed before the flowmeter. Based on considerable experience with checking of carburetor settings in flight, it has been found essential first to remove the vapor before taking a fuel flow reading.

Booster Pumps

Tank-mounted, electric-driven centrifugal booster fuel pumps have greatly improved fuel pressure control on fuel systems subject to vapor conditions. This type pump must be mounted directly on the fuel tank sump, since the impeller acts as a vapor separator and the vapor bubbles coming up from the center of the impeller must be allowed to vent directly up through the fuel supply in the tank. For this reason also the impeller inlet must be faced upward into the tank. The pump not only

serves as an effective vapor separator but it also can serve the purpose of the wobble pump for emergency and starting purposes.

Electric-driven, vane type, positive displacement booster pumps are also often employed, however, this type pump does not act as a vapor separator, it simply provides fuel pressure boost at the engine pump inlet. This type pump should be mounted as close to the tank selector valve as possible when used in the main fuel system. The electric control for the booster pump may be a two-position switch with "manual" for starting the pump at the pilot's discretion and "automatic" for starting the pump when the fuel pressure warning light flashes on. This type pump installation also takes the place of the wobble pump for emergency and starting purposes.

Fuel Tank Pressurization

On airplanes designed for rapid rates of climb, pressurizing the fuel tank system has been employed in order to provide low-altitude pressures in the tanks while the airplane is flying at high altitudes. This system discourages fuel boiling in the tanks at high altitude. This pressurization is obtained by sealing the tank system and using engine manifold pressure as the boosting medium. A regulating unit with the necessary relief valves is incorporated in the piping system. The regulator is set to maintain a predetermined pressure differential above the atmospheric pressure. A pressure relief valve is provided so that excessive tank pressures are not obtained in case of failure of the pressure regulating valve. A vacuum relief valve is also provided for eliminating possibility of collapsing the fuel tanks during rapid descents. A manual override is also provided to make the regulator inoperative, if desired, by opening an auxiliary vent and closing the manifold pressure channel in the main control unit.

Some early installations of fuel tank pressurization were made by teeing into the manifold pressure gauge line for pressure source. This is definitely not recommended since it results in erroneous manifold pressure indications and consequent overboosting of the engine. The engine has several points of connection into the supercharger section, and the tank pressure connection should be made at a point not already utilized.

In addition to the above-mentioned methods of fuel vapor elimination now being provided on the majority of aircraft installations, all the latest models of carburetors have built-in vapor separators. These separators are adequate to handle mild cases of vapor, but they must be supplemented by external separators on installations subject to excess vapor formation, such as on airplanes built for high-altitude operation and those designed for rapid rates of climb.

Induction System

The design of the air-induction system, which the aircraft manufacturer attaches to the carburetor top deck, has become much more complex with the introduction of automatic carburetion. Modern automatic carburetors are required to meter fuel accurately over the full power range of the engine and through an altitude range of from sea level to 30,000 or 40,000 ft. This requires an extremely complex metering unit and, to insure its proper functioning, care must be exercised in introducing the air to it.

Realizing the impossibility of setting up scoop design standards that would fit all possible aircraft installations, the carburetor manufacturers have put considerable effort into the design of their own scoops that eventually may be adaptable to most types of installations. Several papers have recently been published regarding air-scoop design; therefore, rather than review this subject, an explanation of the conditions that cause malfunctioning of a good carburetor setting will be given.

Air-Scoop Design

The modern carburetor meters on the basis of weight of airflow rate (pounds of air per hour). The carburetor venturi is the air meter. When a carburetor air scoop is of such form as to narrow the air stream entering the carburetor top deck, the air meter (venturi) receives air at higher velocity than it was calibrated for, and it records at the metering chamber a higher weight airflow rate than it would for normal velocities at the top deck. The result is that the carburetor meters more fuel than required for the airflow and power. Thus, stratification of the air flowing into the carburetor may enrich the setting.

This flow condition in the scoop, therefore, is most critical and must be overcome by proper design of the duct, its entrance, and its turn into the carburetor. Carburetors are calibrated with zero ram at the top deck and straight-line uniform airflow into its inlet. No metering disturbance will occur if the air after passing through the duct and around its turn can be restored to normal flow at the carburetor top deck. By normal flow is meant flow comparable to that obtained at the time the carburetor was calibrated. Unfortunately, the length of duct between the carburetor top deck and the duct turn is generally too short to allow for proper restoration of the airflow. It is, therefore, necessary to resort to features such as duct vanes, or large area low-velocity turns, and diffusion sections.

If the air opening is close to the top deck of the carburetor and flow is obliquely across it, a condition may arise where the air stream misses the metering units in the carburetor. This usually causes the mixtures to go lean. To avoid this, it is recommended that a portion of straight duct of reasonable length be provided below the lower edge of any duct turn into the carburetor.

Altitude Compensation

Altitude compensation is usually obtained by locating a properly calibrated aneroid unit on the carburetor top deck directly in the path of the air feeding the carburetor. If this aneroid is not subjected to pressure and temperature conditions representative of that in the entire airfeed to the carburetor, then the resultant metering will be incorrect.

Multiple venting of this aneroid unit has made it less sensitive to flow conditions than originally encountered; however, care must still be exercised to avoid stratification of the air temperature pattern in the vicinity of this unit. For this reason, it is necessary to locate the carburetor preheat valve as far from the carburetor top deck as possible. It is preferable to locate this valve before the duct turn. This valve and its method of opening must be carefully studied to avoid drastic changes in the flow and temperature pattern at the carburetor top deck for all positions of the valve.

This same problem of flow and temperature pattern into the carburetor top deck is equally important in the induction system ducts for two-stage and turbo-equipped engines. On installations such as these, an additional problem is encountered, since the induction system must be made to provide correct flow and temperature patterns for conditions of no auxiliary boost as well as for the normal "boost on" condition.

It becomes quite obvious that the design of the airplane portion of the induction system is critical with regard to satisfactory operation of the engine. It, therefore, is important that the induction system duct work be adequately flow-tested before the airplane is flown. Both the engine and carburetor manufacturers are willing to offer their facilities for flow-testing these scoops and duct systems. If these facilities are inadequate, the aircraft manufacturer may find it necessary to arrange for a flow check at another suitable laboratory.

Induction System Ice

No discussion of the airplane induction system is complete without mention of the problem of overcoming carburetor or induction system ice. Considerable investigation has been made into this condition, and the source of

ice formation and the atmospheric conditions conducive to ice formation have been quite thoroughly established. It has also been possible to set up installation requirements that have permitted satisfactory engine operation under icing atmospheric conditions. The installation requirements most generally followed are: (1) a 40°F. preheater with auxiliary alcohol deicing or (2) a 100°F. preheater, with or without auxiliary alcohol deicing.

From the results of considerable flight experience on the moderate-type preheater (40°F.), it can be stated with some assurance that without some form of auxiliary deicing, this preheater alone is inadequate for the rare occasions when the atmospheric conditions are most adverse. On the other hand, from the results of considerable flight experience with the 100°F. preheater, it can be stated that this system has given a satisfactory record under all weather conditions. It is believed, however, that an auxiliary deicing system provides the safety factor so essential for overcoming the hazards of all-weather flying.

To minimize the icing hazard on future engines, care should be taken in the design of induction passages to minimize possibility of ice formation. The passages should increase in area from the bottom of the carburetor to the impeller inlet. There should be no abrupt changes in section or shape. No nuts, bolts, tubes, or other protuberances should be in the induction passage onto which ice may cling and accumulate. It is felt that concentration on overcoming these design factors will practically eliminate the icing hazard.

Exhaust System

Utilization of exhaust jet propulsion during the past year has brought forth new problems for consideration. This system of exhaust requires considerable research which is in progress; however, it is incomplete at this time and therefore specific design criteria cannot be set forth. It is possible, however, to review some of the factors of engine design that will be affected by a jet stack design.

Although having a record of satisfactory engine performance when operating engines equipped with exhaust-driven turbines causing back pressures in the neighborhood of 35 in. to 37 in. Hg absolute pressure, it appears desirable to maintain a limit of 1 in. Hg exhaust back pressure above atmospheric on all other exhaust systems. This has been considered necessary in order to maintain control exhaust manifold design to avoid excessive power loss because of restricted manifold areas. Realizing the importance of the performance returns possible by utilization of jet-exhaust systems, it is not intended to place any hard and fast requirements on the design of such a system, provided some experience with these systems shows no detrimental consequences. At this time there appears to be no reason for suspecting any difficulty.

The designers of jet-exhaust systems have been confronted with the following problems: (1) method of support and possibility of combining the exhaust of two or more cylinders into a single jet; (2) effect of length; (3) effect of jet area; (4) flame suppression; and (5) exhaust gas contamination.

This discussion will be confined to those problems related to engine operation only; therefore, only items (1), (2), and (3) will be discussed.

Stack Design

From the standpoint of simplicity alone, it would be desirable to use individual stacks on each cylinder and exhaust them straight aft, out of the cowl exit slot. This becomes impractical, however, because of space limitations. The stacks usually have to be draped around the back of the engine to clear the carburetor, the air ducts, the oil cooler, the wing, and numerous other components of the installation. To accomplish this, it soon becomes obvious, particularly on twin-row engines, that the stacks from adjacent cylinders should be combined in order not to exceed the space limitations. The problem, therefore, is to decide which cylinders should be combined and how this can be accomplished without getting long stacks with intricate bends. Also related to this problem is the complication of selecting the proper jet size to obtain maximum thrust effect without excessive engine power loss due to high exhaust back pressure.

Effect of "Siamezing"

It is appreciated that the individual stack jet reaction is some three to four times that obtainable from a steady-flow manifold. In order to utilize this maximum jet reaction, the volume of the exhaust pipes between the cylinder and the jet must be kept to a reasonable value. Long, winding stacks are therefore of no benefit from the thrust standpoint. When siamezing two or more cylinders, consideration must be given to the fact that the exhaust functions of the combined cylinders must not overlap, otherwise the peak exhaust pressure that would normally build up to create the jet thrust in the later firing cylinders will react backward on the piston during the exhausting stroke of the earlier firing cylinders, and the effect will be not only to reduce the power of these cylinders but to interfere definitely with the cooling and possibly promote detonation.

There is an overlap of exhaust function between adjacent cylinders in the front and rear banks of radial engines. Combining these adjacent cylinders would therefore be ruinous to the performance of an earlier firing cylinder. From an analysis it appears that the only cylinders that can be satisfactorily siamezed on a twin-row engine are those *adjacent to each other in the same bank.* These cylinders have no overlap in their exhaust functions. There appears to be no other practical combination of cylinders which will operate properly on a single jet.

Effect of Exhaust Back Pressure

Results obtained so far on tests of jets on a single-cylinder and a full-scale engine have clearly indicated that as the jets are squeezed down, the brake horsepower falls off but the engine air consumption, contrary to expectations, remains approximately constant. This means that although the fuel-air ratio has not changed as the back pressure is increased due to the smaller jet the fuel per brake horsepower hour increases considerably. Thus a carburetor setting that is normally calibrated for certain specific fuel consumptions will give substantially higher values when used on an engine equipped with restricted jets. The effect of this increase in back pressure is to enrich the best power point as well as the point of best economy.

To a certain extent this effect of exhaust back pressure on engine air consumption and specific fuel consumption exists on conventional exhaust manifolds, and it is believed that conditions of inconsistent carburetor performance in the airplane are often the result of back pressure and exhaust overlapping effect. Much more investigation into this subject is required before the full effects of manifolding and restricted jets can be established.

Conclusion

It appears that the problems of engine installation are not only numerous but also complex. This discussion has touched on only a few of the major problems and has given no time to the problems encountered when installing such additional complications as exhaust turbines and engines with multistage supercharging with their attendant intercooling and control problems. Only by close cooperation between the engine and aircraft designers will these installation problems be successfully handled.

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The Lockheed Pressure Chamber

FREDERICK P. DILLON,* WARREN DOBLE,† AND H. A. GREENWALD‡

Lockheed Aircraft Corporation

Introduction

The development of pressurized cabin aircraft requires laboratory test equipment permitting the investigation of the coordinated functioning of the entire pressurization system when submitted to simulated flight conditions. This means that the flow characteristics and mechanical functioning of the cabin supercharger, the outflow valves, the control unit, and the complete duct system must be tested under altitude and temperature conditions from sea level to ceiling and from normal temperatures to −70°F.

The Pressure Chamber

In line with this development work, Lockheed has constructed a pressure chamber adequate for testing pressurizing equipment designed for the largest sealed cabin aircraft, as well as for those having single-place cockpits. General views of the chamber are shown in Figs. 1 and 2.

The chamber is a cylindrical steel pressure tank, 24 ft. long by 6 ft. in diameter, of $^3/_8$-in. shell thickness. A steel bulkhead divides the chamber into two equal compartments, designated as C_1 and C_2 in Fig. 3. Compartment C_1 simulates the airplane cabin, while compartment C_2 simulates the atmosphere through which the airplane flies. A small door leads from C_1 through the bulkhead to a small compartment within C_2. This small compartment is a replica of a single-place pressurized cockpit and provides means for testing pressurization systems, as well as for canopy frosting investigation and similar problems of this type airplane. The access door into C_1 is circular and hinged and seals against a gum rubber gasket. It is designed so that it may be opened outwardly or inwardly, thus providing for tests that may require positive pressure in the chamber. The end wall of C_2 is a removable flanged bumped-head, having a smaller auxiliary door in the center, the latter being for quick access to units under test. An overhead track and chain hoist provides means for handling the flanged head and heavy test equipment.

* † ‡ Senior Research Engineers.

Pressure Control

Low pressures, simulating high altitudes within the chambers, are obtained by a vacuum pump of the water-cooled, multivane type, driven at 1,750 r.p.m. by a 5-hp. motor. This pump is capable of evacuating C_1 from an initial pressure of 14.7 to 10 lbs. per sq.in. absolute, at the same time evacuating C_2 from an initial pressure of 14.7 to 4 lbs. per sq.in. absolute in a period of $7^1/_2$ min.

In order to provide means for automatically controlling the pressure within C_2 so that performance of superchargers and their controls can be checked when submitted to typical variable flight conditions, a cam-operated pressure regulator is incorporated. The cam is motor-operated and adjusts a rubber diaphragm responsive to the pressure within C_2 which operates through a balanced pressure regulator to admit more or less air to this compartment. The proportions of the cam permit a typical flight of $1^1/_2$ hours' duration and a pressure variation from sea level to ceiling. Flight cams of various contours provide any desired rate of ascent or descent, as well as allowing either a level or an undulating flight pattern at altitude.

Round observation windows (11 in. diameter) are installed at strategic points throughout both C_1 and C_2, and a small window is provided in the bulkhead for observing the cockpit from C_1.

The window glasses are arranged in layers to lessen heat transfer and for safety. The inside disc is of $^1/_2$-in. thick Plexiglas; two layers of $^1/_4$-in. Plexiglas lie between, with a $^1/_4$-in. plate glass disc on the outside to prevent scratching. A small amount of desiccant is placed between each layer to absorb any moisture trapped between discs. Clear vision through the windows is afforded under all testing conditions.

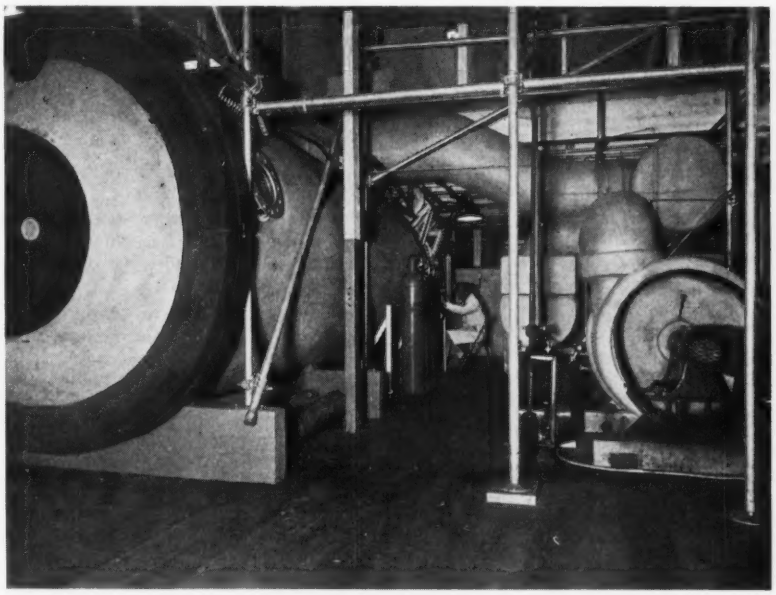

Fig. 1.

Temperature Control

Temperature reduction is obtained by a two-stage Freon and dry ice system. The first stage consists of a four-cylinder compressor driven by a 10-hp. motor, a shell and tube Freon condenser, and extended surface evaporating coils. The second stage is a dry ice-alcohol spray system. The

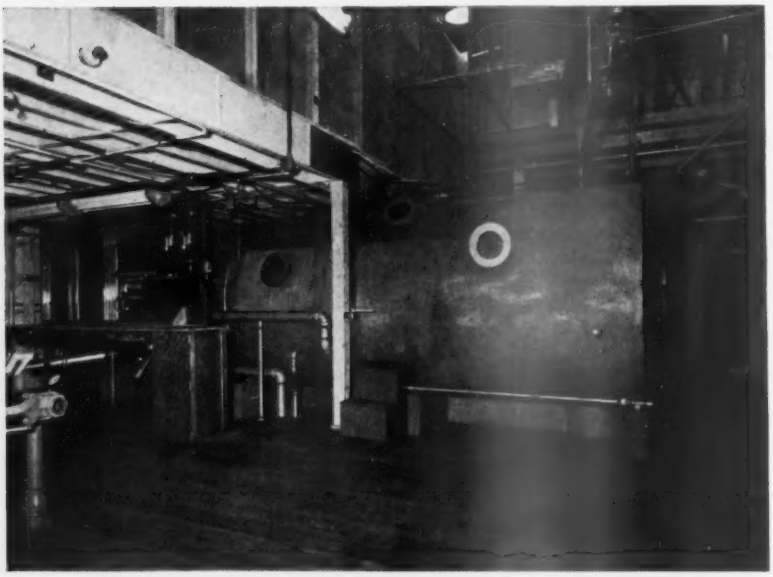

FIG. 2.

Freon cooling coils are arranged in duplicate with necessary valving to enable defrosting of one coil while the other is in operation. Defrosting is accomplished by valve-controlled water sprays and suitable drains. This switchover can be accomplished without interrupting operations. The valves marked "A" in Fig. 3 are the expansion valves and those marked "B" are the shutoff valves. The Freon coils lower the temperature to approximately −10°F., and further cooling is accomplished by the alcohol coil, which can lower the air temperature to approximately −70°F. The temperature is under thermostatic control. During operation the Freon unit carries the refrigeration load to its full capacity, after which the dry ice cooling unit is operated when more refrigeration is required.

Air Circulation System

A multistage centrifugal blower connected to the air circulation system manifold circulates the air through the cooling coils and C_2. The blower draws the air from the bottom of C_2 and passes it through the refrigeration coils to a rotary distributor valve in C_2 having three outlets controlled by a shaft operable from outside the chamber. Flexible pipes connected to the valve can be run to any point in C_2 requiring refrigerated air. Ram velocities up to 600 ft. per sec. are made available by this system.

The outside of C_2 and the air ducts running to and from the refrigeration coils are insulated with 6 in. of cork set in asphaltic cement and having a sanded exterior finish. The cork on C_2 extends 4 ft. beyond the bulkhead to lessen heat flow from C_1 and the laboratory air through the shell of the tank. The bulkhead is similarly insulated.

Control Equipment

All pressure chamber machinery is operated from a remote control board. The cooling water flow through the refrigeration condenser and vacuum pump is automatically controlled. On a separate board and table is mounted the usual bank of manometers, potentiometers, and a recording oscillograph for charting instantaneous pressures and temperatures.

Pipes run from C_1, C_2, and the cockpit to a "safety station" where quick-opening emergency relief valves and vacuum gauges are under the attention of a technician while personnel are in the chamber. In addition, emergency relief valves are provided within C_1 and the cockpit.

The access passage or "tunnel" through the bulkhead from C_1 to the cockpit is provided with an aluminum alloy door which lies at a slight angle from the vertical against a door jamb provided with rubber sealing strips. No locks or hinges are required, since pressure difference between C_1 and the cockpit holds the door firmly against the rubber seal.

Testing Pressurizing Equipment

When testing the pressurizing equipment of the larger aircraft, the supercharger is mounted in compartment C_2 and driven by a gas engine by means of a shaft passing through the shell of compartment C_2 (Fig. 5). The supercharger receives air from the air blast previously mentioned, which simulates ram effect in flight, and delivers supercharged air to compartment C_1, which simulates the cabin. Pressure within C_1 is controlled by the operation of the outflow valve in C_1 which adjusts the rate of flow of air from C_1 to C_2. The outflow valve is actuated by the control panel in C_1. The control panel is sensitive to the pressure within C_1.

When running tests with pressurizing equipment within the cockpit, the C_1 chamber may be operated at any pressure between laboratory and cockpit pressure. In this way it is useful as an observation chamber. Control of pressure within C_1 is secured by the

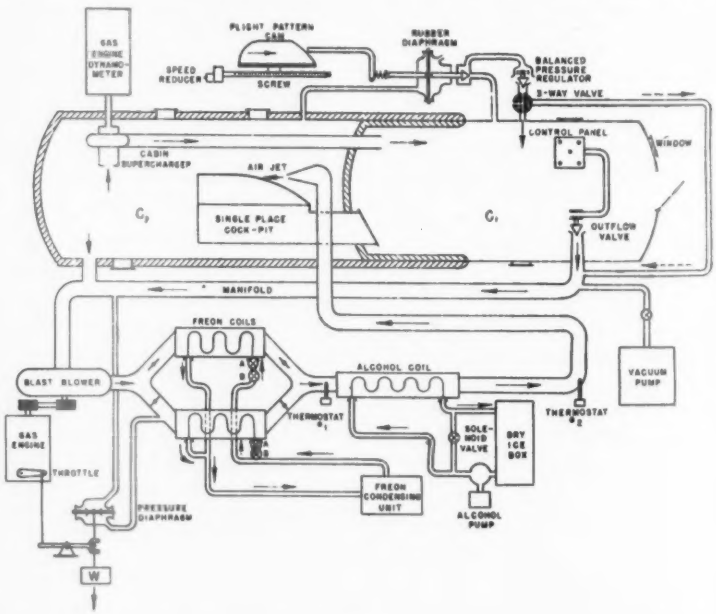

FIG. 3.

operation of the outflow valve in C_1. Flow of air through C_1 is controlled by the balanced pressure regulator, which operates in response to pressure variations in C_2. As the vacuum pump draws air from C_2, slight pressure variations in C_2 actuate the balance pressure regulator, thus causing variations of flow of laboratory air into C_1. This flow causes slight pressure variations in C_1 which cause operation of the outflow valve of C_1. In this manner the pressures within C_1 and C_2 are controlled and C_1 is ventilated.

In testing the cockpit pressurizing system, the supercharger with all of its controls is mounted within the cockpit. The supercharger draws air from C_2, pressurizes the cockpit, and discharges overflow back to C_2 through the outflow control valve. When running cockpit tests without pressurizing equipment within the cockpit, its pressure is that of C_1 and is ventilated from that chamber by means of the piping system of Fig. 4. In this system, means are provided for accurately controlling cockpit humidity and temperature so that canopy frosting performance can be explored. The system comprises an air distribution circuit between C_1 and the cockpit. A small motor-driven blower delivers air from C_1 to the cockpit. A thermostatically controlled electric heater in the delivery pipe brings the air to the desired temperature. Humidity of the air is regulated by admitting steam to the inlet of the blower; if the air in C_1 is too humid, dryer air is admitted. This is secured by piping air from the vacuum pump into C_1 and liberating smaller or greater quantities as required at the inlet to the blower. This air, coming from the refrigeration system of C_2, is extremely low in moisture content. A small electric water heater provides steam for humidification. This device is supported adjacent to the blower inlet of C_1 and is fed water by a small needle valve. In order to keep as much machinery as possible out of C_1, the blower is mounted on the outside. The blower housing is capable of withstanding any low pressure found within the cockpit, and the blower shaft is equipped with a pressure seal. In the return pipe line from the cockpit to C_1, a steel box with a glass cover has been provided for holding wet and dry bulb thermometers.

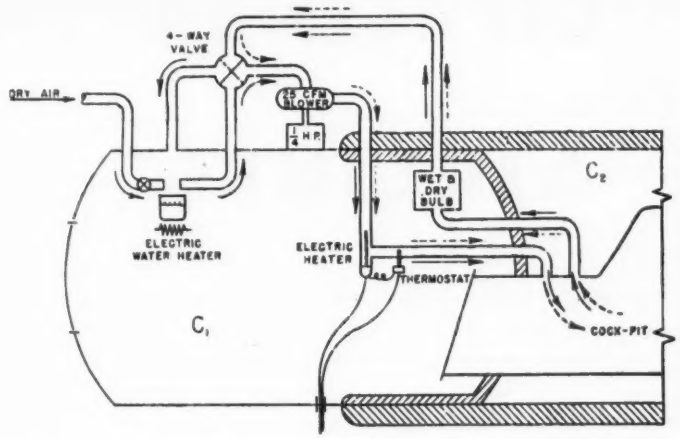

FIG. 4.

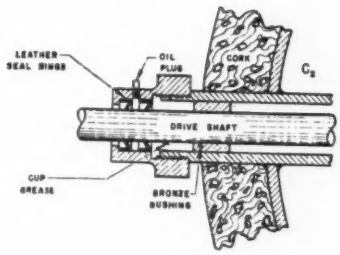

FIG. 5.

PILOT TRAINING

The chamber may also be used for high-altitude pilot training. There is ample room within C_1 for three pilots and an attending physician or instructor. Oxygen containers are installed outside, and outlets are provided inside for connecting oxygen masks. A complete intercommunicating telephone system is installed whereby each pilot may converse freely with the outside operator stationed at a convenient observation window. Dual flight instruments are provided inside the chamber and at the operator's station. A sensitive system of valving provides any rate of climb or descent desired by either the observing operator or those inside the chamber.

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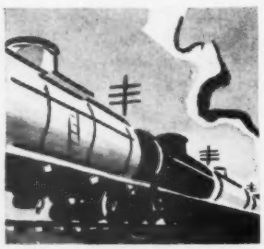

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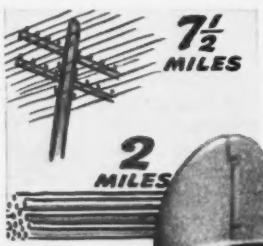

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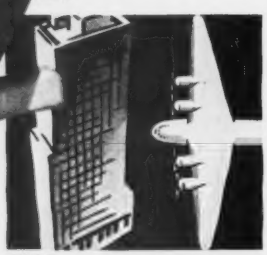

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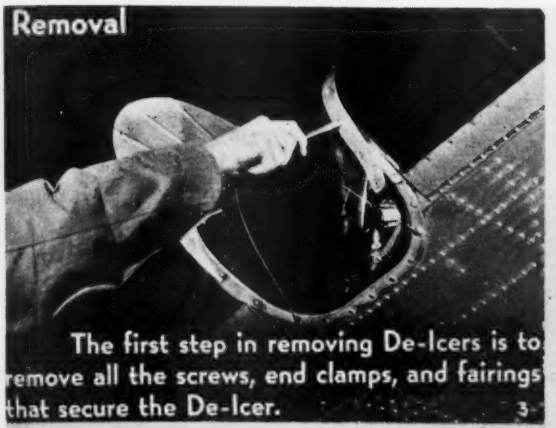
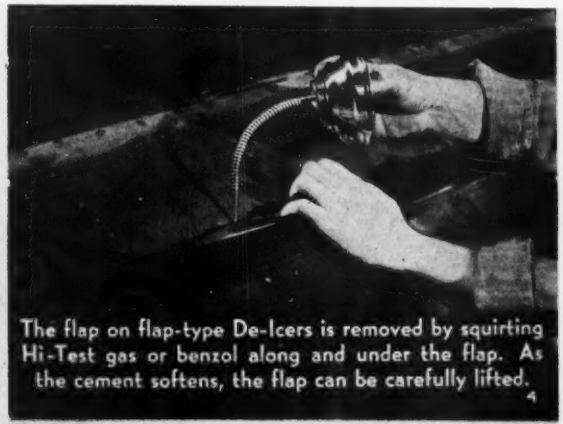
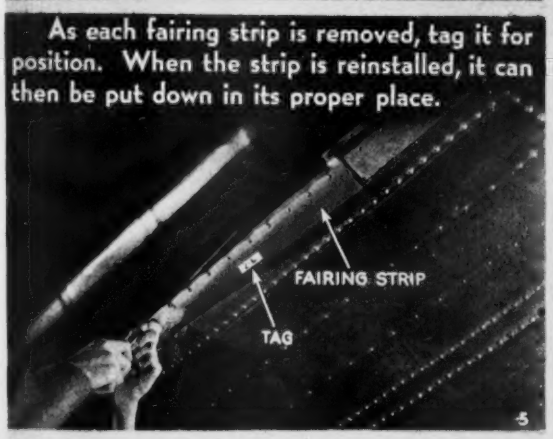
On this and succeeding pages are scenes from one of these films, *De-Icer Servicing and Installation*, showing various steps in removing, repairing, storing and installing De-Icers. The films are supplemented with pocket-size booklet versions for distribution to members of the audience following a presentation.

Other films in the series are *The Development of the De-Icer*, covering the fundamentals of ice formation and the operation of the De-Icer in removing it, and *De-Icers and Design* and *De-Icer Operation;* the last two are now in preparation.




The flap on flap-type De-Icers is removed by squirting Hi-Test gas or benzol along and under the flap. As the cement softens, the flap can be carefully lifted.
4


As each fairing strip is removed, tag it for position. When the strip is reinstalled, it can then be put down in its proper place.
FAIRING STRIP
TAG
5

Scrub the fairing strips and underside of the flaps lightly with gasoline or benzol, to remove old rubber cement and primer. These solvents are harmful to the De-Icers so use them sparingly.
8

Just as the metal skin may be damaged, so may the De-Icers be injured. Therefore — at this time they should be carefully inspected and repaired. Stretching the rubber will aid in locating small holes.
9

First wash the damaged area with a mild soap and water. Protect the De-Icer with a buffing shield during the patching operation.

1. Roughen with wire buffer.
2. Smooth with emery buffer.
3. Clean with benzol.
4. Remove fabric from patch.
5. Apply No. 1 cement to patch and De-Icer.

11

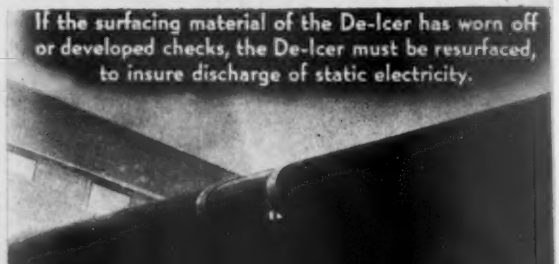
When the cement has become tacky—

6. Apply the patch.
7. Allow 15 minutes for patch to set, then clean with benzol.
8. Brush on Prenite-Graphite paint to restore surface.

12

Use sheeted De-Icer rubber for large patches. It must be applied with two coats of rubber cement on the roughened surfaces. Rubberized fabric must be applied to the underside of the De-Icer to back up lengthwise patches. This fabric stretches one way. Apply it with the stretch crosswise to the De-Icer.

13



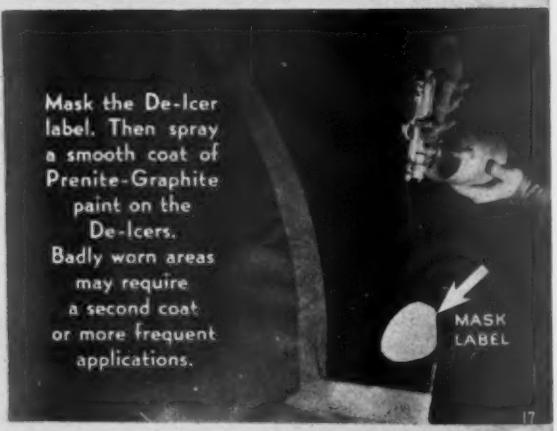
If the surfacing material of the De-Icer has worn off or developed checks, the De-Icer must be resurfaced, to insure discharge of static electricity.

Resurfacing or patching can be done with the De-Icer either on or off the wing.

15

To prepare the De-Icer for resurfacing, first scrub its outer surface with cheesecloth moistened with butyl acetate, or isopropyl acetate, to clean and smooth the old surface.

16



Mask the De-Icer label. Then spray a smooth coat of Prenite-Graphite paint on the De-Icers. Badly worn areas may require a second coat or more frequent applications.

17

De-Icer Storage

Lay out the De-Icer with the outer, or black, side up. Tuck the flaps under. Tape the ends of the metal beads and metal air connections to prevent injury to the rubber.

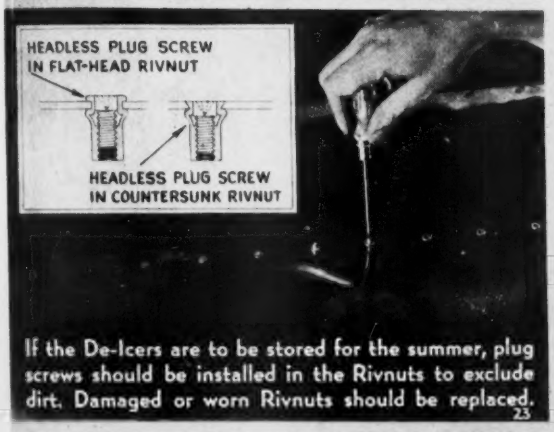
19

When thoroughly clean and dry, De-Icers may be rolled in a coil, starting with a 4-inch to 6-inch diameter. Wing De-Icers are rolled from the connection end—tail De-Icers from the tip end.

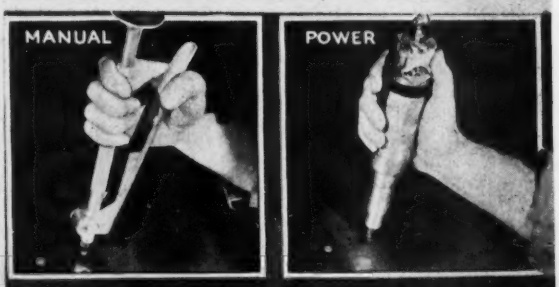
20

Wrap in heavy paper, turning the edges in to keep out light. Be sure the De-Icer is not wrinkled when it is stored. Store in a cool, dark, dry place. De-Icers will keep indefinitely with these precautions. 21

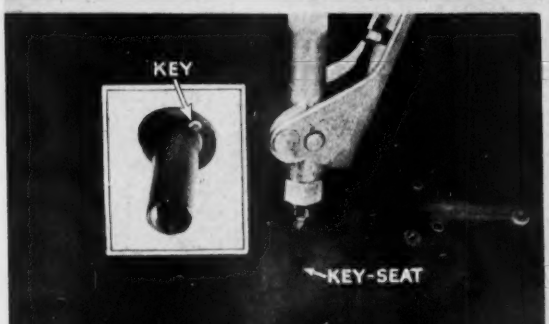
After the De-Icers are properly stored, remove the tapes from the wing. Wash off the talc with an approved cleaning agent. 22



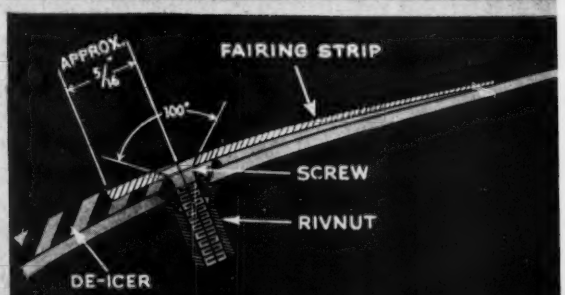
If the De-Icers are to be stored for the summer, plug screws should be installed in the Rivnuts to exclude dirt. Damaged or worn Rivnuts should be replaced. 23



The heading tool heads the Rivnut on the underside of the skin. A power-operated heading tool made by the Chicago Pneumatic Tool Co. is also available. This unit is operated by compressed air and is extremely fast in operation. 24



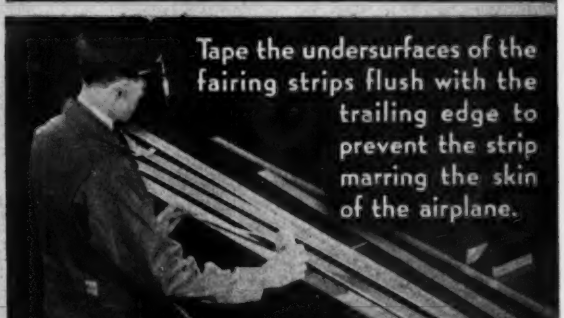
If new Rivnuts of the keyed type are being installed for the first time, the key-seat cutter is used to cut a slot for the Rivnut key. 25



If a fairing strip is lost or damaged beyond repair, a new one can be fitted as shown. Locate holes in blank fairing strip with indexing tool to insure an accurate fit. Use only the correct fairing strip for each De-Icer. 27

Installing New De-Icers

To prepare the airplane for new De-Icers, apply adhesive tape over all skin laps and rivet heads in the De-Icer area to prevent localized wear on the undersurface of the rubber. Around salt water use a coat of P-27 primer on the skin under the De-Icer. 28



Tape the undersurfaces of the fairing strips flush with the trailing edge to prevent the strip marring the skin of the airplane.

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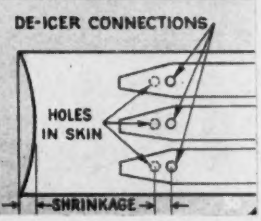
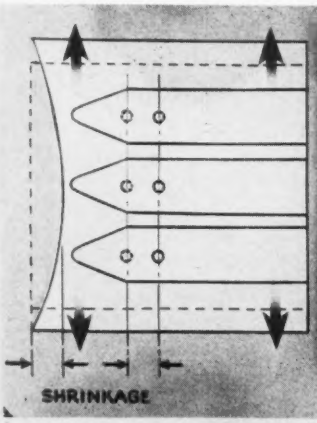
* THE SHOCK ABSORBING UNITS ON AN AIRPLANE'S LANDING GEAR. THE NAME IS DERIVED FROM THE WORDS "AIR" AND "OIL"—THE FLUIDS USED TO DISSIPATE THE LANDING SHOCKS.

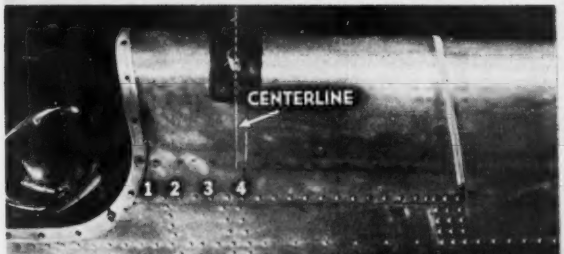
When rubber is stretched in one direction, it tends to shrink in the other direction.

When the De-Icer is stretched around the leading edge, it shrinks endwise. This shrinkage might cause the air connections to cock and bulge.

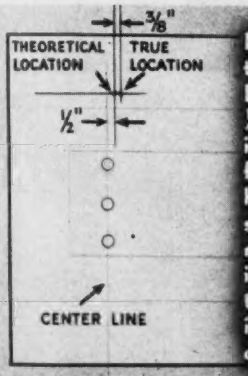




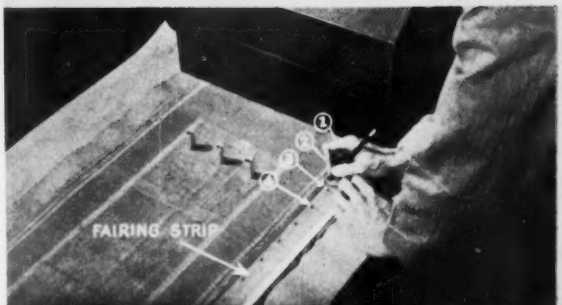
To avoid this, the De-Icer is offset a small amount in the opposite direction to the shrinkage at the air-connection end. The amount of offset can best be learned by practical experience. Of course, if the air connections are in the center, no offset is necessary.



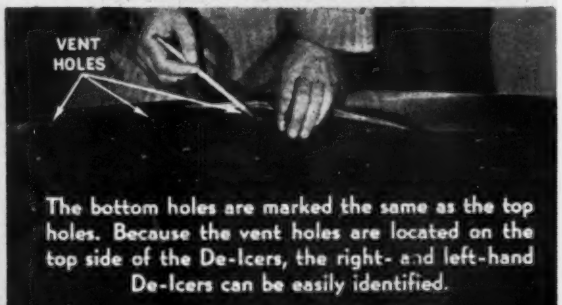
Draw a centerline through the connection holes. Measure the distance from the centerline to the nearest Rivnut. The centerline here is nearest Rivnut No. 4. This is the starting point for laying out the attachment holes in the De-Icer. 32



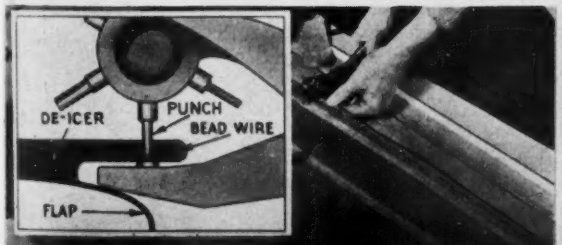
Locate the centerline of the air connections on the De-Icer. In this example, ½ inch from the centerline is the theoretical location for the No. 4 attachment hole. But, since experience shows that this De-Icer must be offset ⅜ of an inch, the true location of the No. 4 attachment hole is ⅛ of an inch plus ½ inch, or ⅝ of an inch from the centerline.



Lay the proper fairing strip on the edge of the De-Icer as shown. Line up the No. 4 hole of the fairing strip with the No. 4 mark on the De-Icer. The layout of the holes is now marked directly from the fairing strip. 34

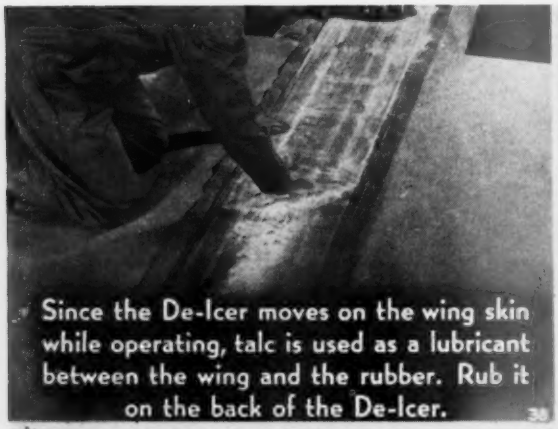


The bottom holes are marked the same as the top holes. Because the vent holes are located on the top side of the De-Icers, the right- and left-hand De-Icers can be easily identified. 35

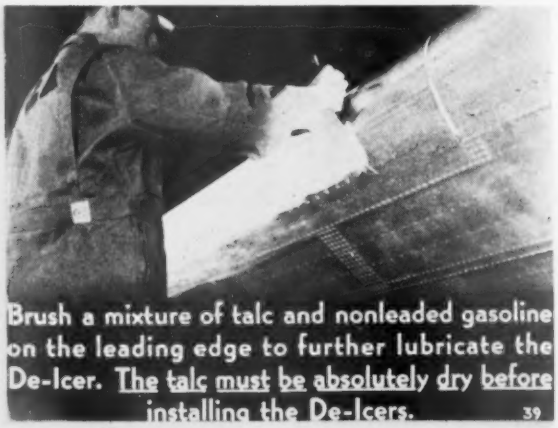


Punch the holes in the fabric-reinforced rubber so that the metal bead will bear against the screws when installed. Around the tip curve the De-Icer should be punched only after the straight part has been located on the wing. Be careful not to damage the flap. 36

Slide the rubber back on the beads to curve the tip of the De-Icer to conform roughly to the wing-tip curve. 37



Since the De-Icer moves on the wing skin while operating, talc is used as a lubricant between the wing and the rubber. Rub it on the back of the De-Icer. 38

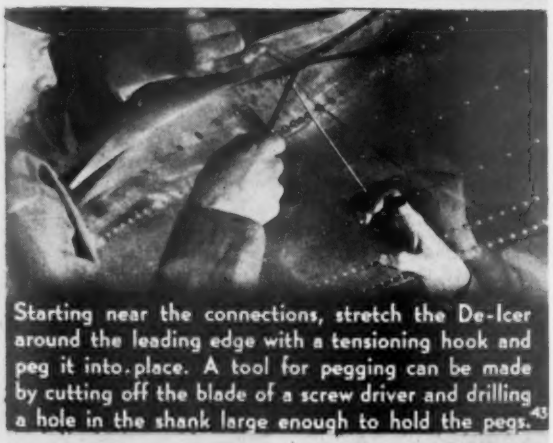


Brush a mixture of talc and nonleaded gasoline on the leading edge to further lubricate the De-Icer. The talc must be absolutely dry before installing the De-Icers. 39

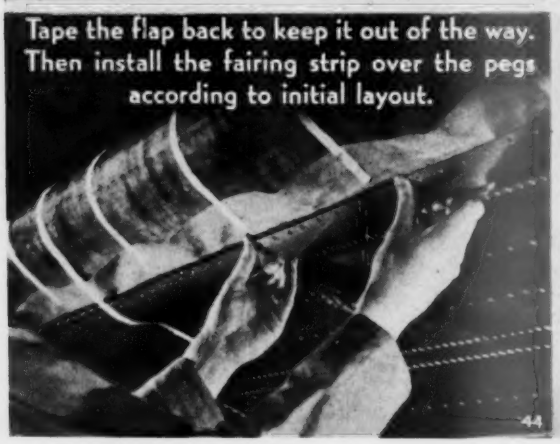
Place pegs in the Rivnut holes on the top of the wing. Hang the De-Icer and fairing strips on these pegs. Be sure that the De-Icer is in its proper position at the air connections. 40

Attach the fairing strips and De-Icer with special attaching screws, removing the pegs as the screws are driven. Do not tighten the screws. Leave them loose. 41

Remove the summer caps. Fish out the hoses and connect and safety them to their respective connections on the De-Icer. Then, adjust the connections properly in place in the wing. 42



Starting near the connections, stretch the De-Icer around the leading edge with a tensioning hook and peg it into place. A tool for pegging can be made by cutting off the blade of a screw driver and drilling a hole in the shank large enough to hold the pegs. 43



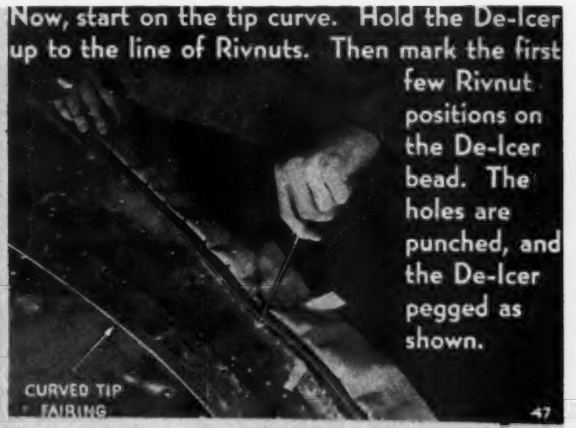
Tape the flap back to keep it out of the way. Then install the fairing strip over the pegs according to initial layout. 44

Replace every other peg with a screw and tighten securely.

46

Now, replace the rest of the pegs with screws and be sure that they are all tight. Finally, tighten all screws along the top attachment.

Now, start on the tip curve. Hold the De-Icer up to the line of Rivnuts. Then mark the first few Rivnut positions on the De-Icer bead. The holes are punched, and the De-Icer pegged as shown.



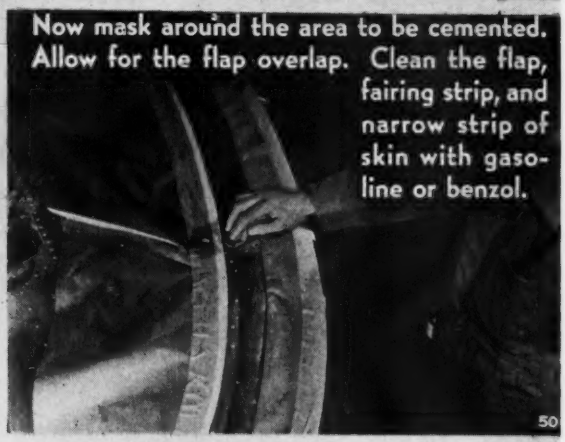
47

As the De-Icer is pegged along the wing tip, be careful to fit the curve of the tip and to keep all puckers at right angles to the leading edge.

Place the curved fairing strip over the pegs. Then replace the pegs with screws. Tighten all screws progressively toward the tip.

49

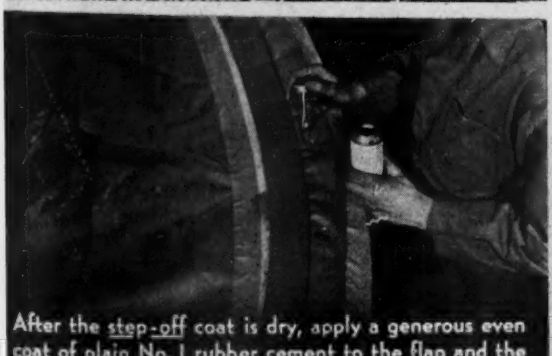
Now mask around the area to be cemented. Allow for the flap overlap. Clean the flap, fairing strip, and narrow strip of skin with gasoline or benzol.



50

Apply a smooth coat of primer No. 8 on the fairing strip and narrow strip of skin, but omit primer over screws. Brush in one direction only — do not go back over. 51

After the primer coat is thoroughly dry, apply an even step-off coat made up of half primer No. 8 and half No. 1 rubber cement. Brush lightly in one direction. Do not go back over it. 52



After the step-off coat is dry, apply a generous even coat of plain No. 1 rubber cement to the flap and the primed area. Brush in one direction, and do not go back over either of these coats. Apply a second coat of cement, if necessary. 53

After the cement has become tacky, work the flap into place from front to rear. Puckers can be removed by pulling the flap toward the trailing edge and working them out with the fingers. 54

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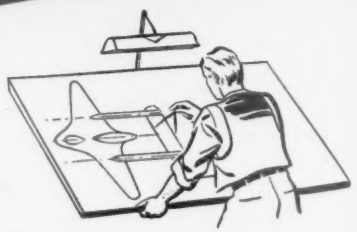

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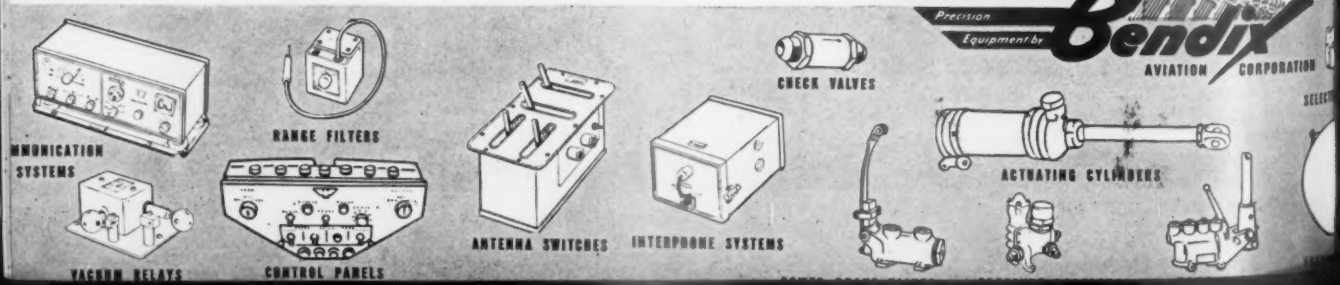
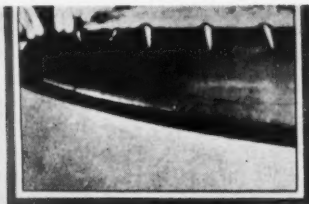
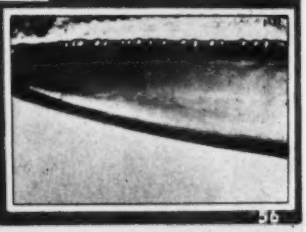


In laying the flap around the tip, pull the flap at right angles to the fairing strip and stick lightly into place about every four inches. 55



1. Pull out the large wrinkles at right angles to, and away from, the leading edge. This forms small wrinkles.

2. These break up into still smaller wrinkles.



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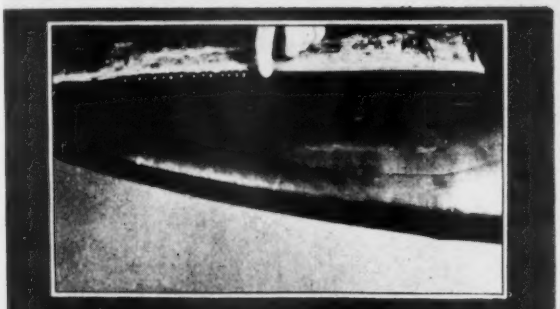
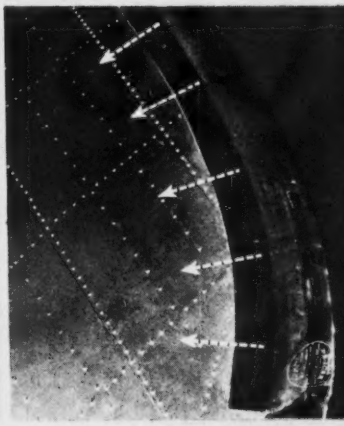


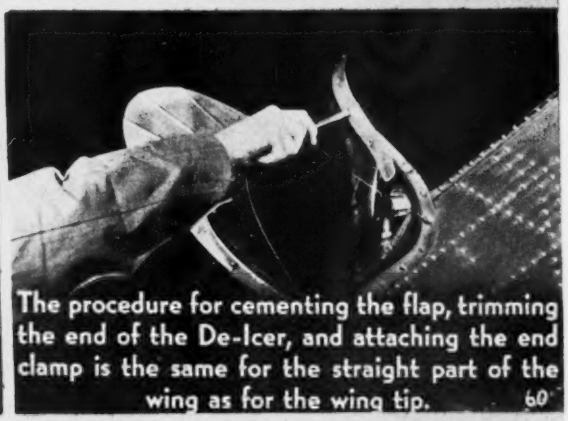
Remove the remaining wrinkles by smoothing the flap rearward. Roll the entire flap, including the straight section, with a rubber roller to insure a strong bond. 57



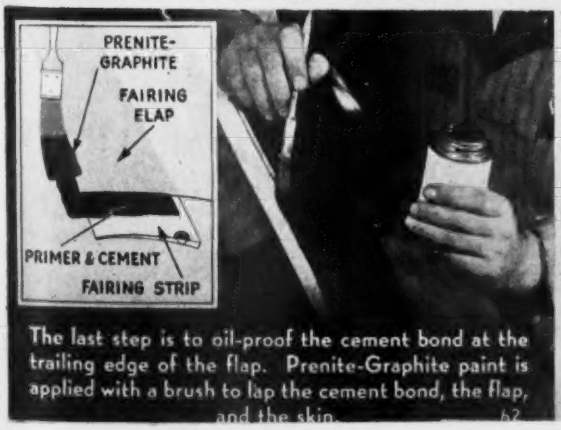
The completed job should be smooth. Remember, when pulling the flap to remove wrinkles, it should be pulled at right angles to the fairing strip.

58

Cut the bead wires — then trim the tip of the De-Icer to suit. Screw the end clamp strip tightly in place. 59

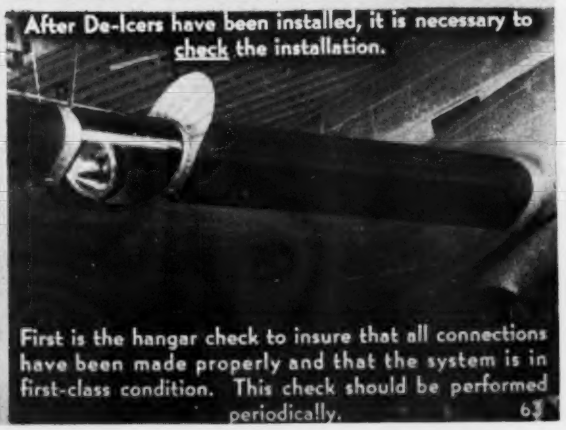


The procedure for cementing the flap, trimming the end of the De-Icer, and attaching the end clamp is the same for the straight part of the wing as for the wing tip. 60

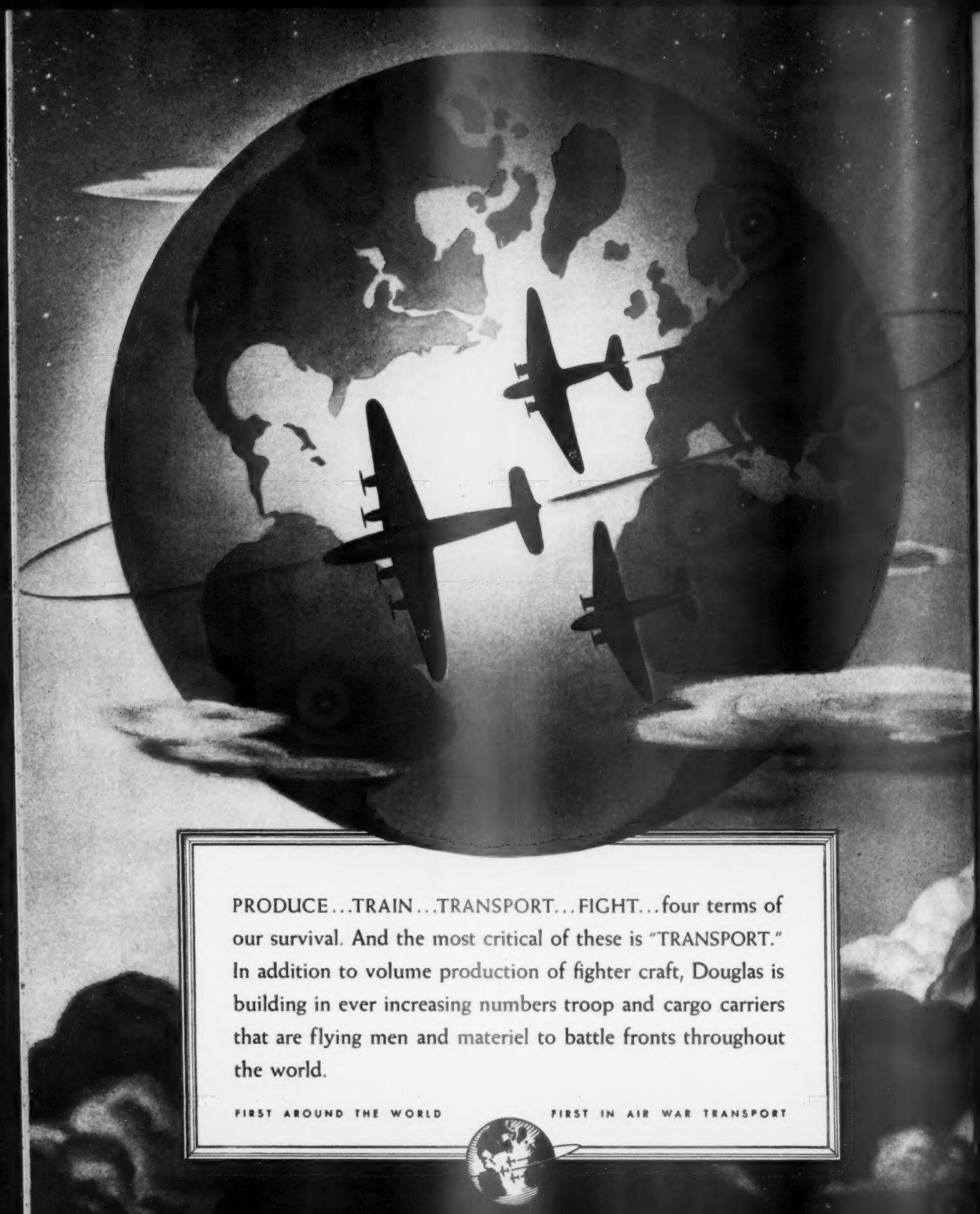


The last step is to oil-proof the cement bond at the trailing edge of the flap. Prenite-Graphite paint is applied with a brush to lap the cement bond, the flap, and the skin. 62

After De-Icers have been installed, it is necessary to check the installation.



First is the hangar check to insure that all connections have been made properly and that the system is in first-class condition. This check should be performed periodically. 63

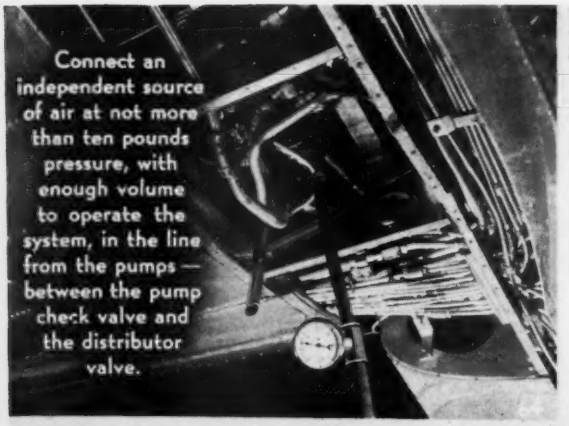


PRODUCE...TRAIN...TRANSPORT...FIGHT...four terms of our survival. And the most critical of these is "TRANSPORT." In addition to volume production of fighter craft, Douglas is building in ever increasing numbers troop and cargo carriers that are flying men and materiel to battle fronts throughout the world.

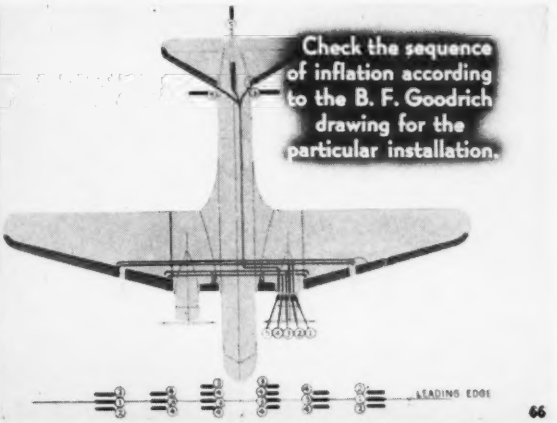
FIRST AROUND THE WORLD

FIRST IN AIR WAR TRANSPORT

Now, more than ever, depend on Douglas

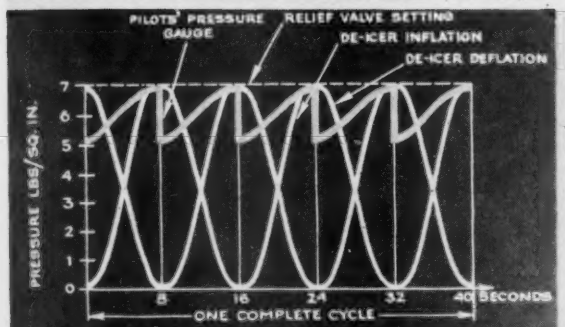


Connect an independent source of air at not more than ten pounds pressure, with enough volume to operate the system, in the line from the pumps — between the pump check valve and the distributor valve.



Check the sequence of inflation according to the B. F. Goodrich drawing for the particular installation.

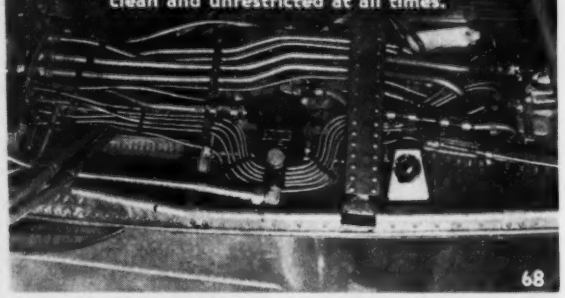
66



A complete inflation cycle should occur every 40 seconds. If a five-port distributor valve is used, a peak should show on the gauge every eight seconds.

67

If the De-Icer cycle is slow, check the voltage and the distributor valve. If a De-Icer cell is sluggish, check the slow tube, its plumbing, and connections for restrictions or congealed oil. Keep all lines clean and unrestricted at all times.



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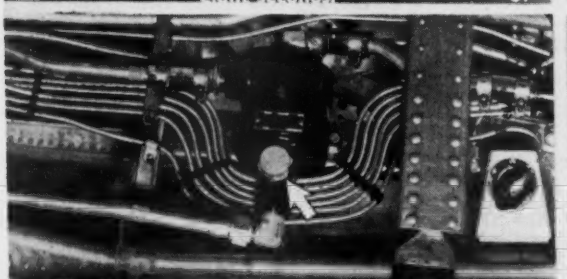
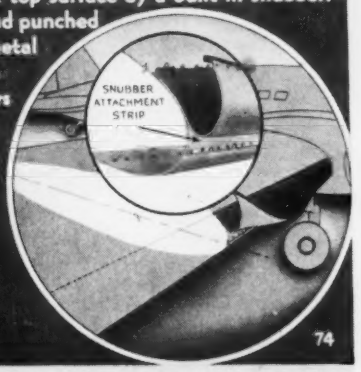


The De-Icer operating pressure may be adjusted by the pressure relief valve. This should be set so that the cockpit gauge reads about seven pounds with the motors running normally. This completes the ground check. Before each take-off, a routine operating check of the De-Icer system should be made.

70

On wide De-Icers the tube area is prevented from creeping toward the top surface by a built-in snubber. Holes are located and punched through the wide metal insert which is then attached with screws to an intermediate row of Rivnuts. The metal insert is notched if buckles develop. The major part of the De-Icer is then attached in the regular way.



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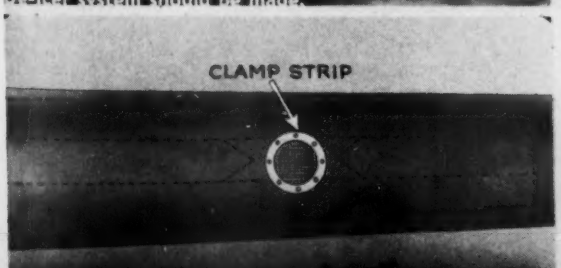
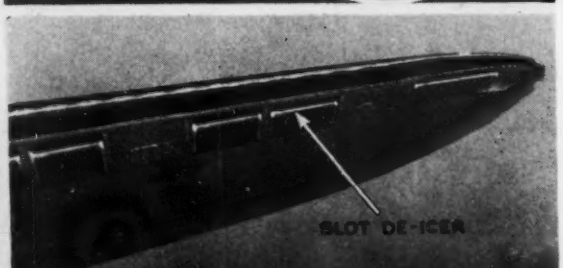


When cutouts are to be made in the De-Icer, cut the reinforced area to the outline of the opening. Punch holes to suit the Rivnuts around the opening. Attach the special clamp strip or frame. Then install the main part of the De-Icer in the regular manner.

75



To attach slot De-Icers, locate the holes from the Rivnuts and punch the holes through the metal insert in the De-Icer. Attach with standard attachment screws. End clamps are installed in the regular manner. No fairing strips or cement are required.

76

Here Come
THE CORSAIRS
High-powered Vought Corsairs are rolling off production lines for the United States Navy.
With their 2,000-horsepower air-cooled engines, these mighty ship-board fighters pack the firepower, range, climb and speed at all altitudes to take the measure of the best the enemy can produce.
VOUGHT-SIKORSKY AIRCRAFT
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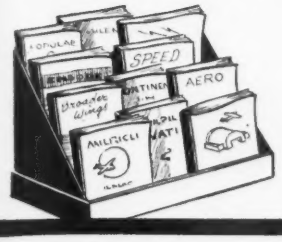

Periodicals

Accessories

Fairlead Guide Blocks. A new type of adjustable plastic fair-lead guide block for aircraft controls has recently been introduced. It consists of three pieces of molded macerated phenolic which form the guide block when fitted together and locked into position. The two matched housings are placed with lugs in such a way that the angle of opening is adjustable. The center plug has a scooped-out section that serves as the major bearing for the cable. The plastic guide eliminates the necessity for drilling special angular holes in the guide blocks. A special feature is that the guides can be assembled and disassembled without unthreading the cable, thereby facilitating quick and easy replacement. Dimensions and specifications are given for the new fair-lead guide blocks. *Modern Plastics*, July, 1942, pages 62, 63, 112, 11 illus.

The Dornier Drogue. Data are given on the construction and operation of the new diving brake employed on the Dornier Do 217E bomber. Representing a departure from the ordinary type of aerodynamic brake mounted on each wing, this brake is located on the extreme end of the fuselage. This location, applying the retardation force from one source along the longitudinal axis of the machine, is designed to produce a smoothly controlled dive. It also makes the brake less vulnerable to gunfire during the diving operation. *Flight*, July 2, 1942, page 17, 1 illus.

Comfortization of Military Aircraft, Part 2. Albert A. Arnhym. The first part of this article (AERONAUTICAL ENGINEERING REVIEW, July, 1942, page 46) discussed a list of comfort features essential for the efficient performance of aircraft crews which are intended to maintain their physical and mental condition to produce the utmost efficiency.

Part 2 gives further consideration to air supply. The fundamental requirements for a properly heated, evenly distributed and well-planned air supply are outlined. The seven major conditions that must be considered by the comfortization engineer are set forth, consisting of (1) sufficient oxygen, (2) constant circulation, (3) minimum carbon dioxide, (4) sufficient but not too much cooling power, (5) proper distribution of humidity and heat, (6) prevention of high-heat inlet temperatures, (7) safe pressure at high altitudes. Methods of calculating the proper quantity of air are suggested, giving consideration to the effects of high altitude and the low air pressures there encountered. Two known methods for overcoming the effects of low atmospheric pressure at great altitudes are defined. Problems of humidity control are discussed.

For the so-called cockpit-type of aircraft, special arrangements are suggested for the prevention of the entrance of harmful gases, fumes and odors. This type of airplane generally receives enough air by natural infiltration but some disadvantages are shown.

Different problems are encountered in supplying air for the cabin type of aircraft, all of which are discussed, including the mechanisms to be provided and the supercharging of different types of aircraft. The so-called "compartment type" airplane, such as transports, cargo and ambulance planes and long-range bombers, is slightly different from commercial airplanes of corresponding size, but the problems of air supply require particular consideration, about which detailed information is given. *Aero Digest*, August, 1942, pages 220, 223, 224, 226, 228, 229, 230, 234, 236, 8 illus.

Bomb Sight for Light Airplanes. Simplified bomb sights have been made which are said to have numerous practical uses in light airplanes. Details of one of these are given, as well as results of actual tests. *Aero Digest*, August, 1942, page 214, 3 illus.

Aerodynamics

Minimum Induced Drag. J. Lockwood Taylor. For any given air-

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PEDAL PUSHING TO ALTITUDE...

• Keynote to air mastery—high-altitude flying—forces the stratosphere pilot to prepare by breathing pure oxygen while riding a stationary bike, to avert the "bends." Thus have pilots of Republic Aviation's P-47 Thunderbolt become pedal-pushers and *the world's highest fliers.* Republic Aviation Corp., Farmingdale, L. I., N. Y.

REPUBLIC AVIATION

REPUBLIC AVIATION

plane wing arrangement there is a definite lift distribution associated with the minimum value of induced drag of which a particular span is capable. The theory giving the appropriate lift distribution and resulting induced drag coefficient is perhaps not so well known, the writer states. The article is devoted to a mathematical exposition of the theory. *Aircraft Engineering*, July, 1942, page 196.

Wing Tips and Horse Teeth. Francis H. Clauser. Maintaining that mathematical theories have not yet been worked out to describe completely the conditions of airflow around the tip of a wing, the writer reviews briefly the available data to emphasize how much information is still lacking. He explains the wing-tip vortex and directs attention to two critical cases that must be considered in designing wing tips. The first involves the wing at a high angle of attack during the periods of landing or take-off when the airplane is close to the stalling condition. The cause of loss of lift is analyzed. The second design case involves the high-speed condition in which there is no concern about stalling but the emphasis is on low drag. Steps to be taken to overcome this difficulty are outlined. The four-engined Douglas C-54 combat transport is cited as an example of mathematically derived wing-tip design. *Western Flying*, July, 1942, page 56, 1 illus.

Air Cargo

Dirigible Advocates Urge Rigid Airships for Cargo, but Airplane Men Say No. The advantages of lighter-than-air craft are summarized and major objections to this type of aircraft are set forth in a discussion of the relative merits of airplanes and dirigibles. The difficulties in finding materials and the possibilities of using substitute materials are considered. *American Aviation*, August 1, 1942, page 8.

Cargo Planes. In a brief article, the possibility of utilizing aircraft for war-cargo transportation is assessed. The factors favoring such a development are discussed, as well as those which have tended in the past to retard the expansion of air-cargo operations. *Time*, July 20, 1942, page 60, 1 illus.

Air Power

Brazilian Air Power. Studies are presented of the position of Brazil as one of the most active of the South American countries in cooperation with the United Nations. Its proximity to western Europe and western Africa makes it vulnerable to an Axis attack by air, which is assumed to be an important reason for the willingness of the Brazilian authorities to make its resources available. Mineral, agricultural and industrial resources of the country are briefly outlined. The facilities for manufacturing aircraft and a roster of available airplanes is presented. *Air News*, August, 1942, pages 8–10, 11 illus.

The views and opinions expressed in this section are exclusively those of the writers or publications named. They are in no case to be construed as those of the Aeronautical Engineering Review or the Institute of the Aeronautical Sciences.

The Employment of Air Power. Capt. Norman Macmillan. Stating that air power, applied at the right time and in the requisite force, has many times proved to be the decisive factor in this war, the writer cites numerous instances to confirm his opinion. Comparisons are drawn through the history of Britain's early wars with the development of older types of armaments. Certain aspects of the first World War are reviewed and the belief is expressed that the German military leaders made the same mistake in underestimating British strength in this war that the German general staff made in the former conflict. Strategic bombing is discussed from the standpoint of its effects on the civilian population and on the defense organization that must be provided by the enemy to combat it. Another indication of the value of strategic bombing is the disruption of the enemy's transportation and distribution facilities. It is emphasized that such operations must be carried out on a scale making it impossible for the enemy to overcome the disorganization it creates.

Reasons are advanced for the defeats of the Allied armies in May and June, 1940, and the Battle of Britain is recalled in a discussion of the functions of land and air warfare. Considerations of personnel are set forth in a comparison of the operations of bombing and reconnaissance. Britain's defensive problem is compared with that of Germany, to which the writer adds a formula for strategic bombing based on the relationship of weight of bombs dropped to the number of operational hours flown. Since air power is universal, it is argued that aircraft must be provided to cooperate with naval forces as well as with land armies. *Aeronautics*, July, 1942, pages 32–36.

The Proving of the Air Weapon. The struggle by Gen. "Billy" Mitchell to prove that the airplane has superseded the battleship and that the dominance of air power indicated the need for a unified air arm is traced from 1920 to 1926. Several experiments made by the United States Navy in the "airplane versus battleship" controversy are outlined. *The Aeroplane*, June 26, 1942, pages 724, 725, 6 illus.

The Soviet Air Force After a Year of War. Lt. Col. Nikolai Denisov. An officer of the Soviet Air Force reviews the part air power has played in Russia's past year of war with Germany and reports on the Soviet's growing air strength. In telling of past events he blames the failure of the Luftwaffe's initial campaign in Russia on the fact that Germany's plans were based on a policy of intimidation and numerical air superiority. Air supremacy, he alleges, can be won only by skill, bravery and heroism interwoven with qualitative and quantitative superiority, and he shows where the Russians have displayed these qualities.

In his report of the development of Russian air power in the past year, the writer takes into account the eastward movement of Russian aircraft factories, new types of Soviet airplanes and the assistance of Britain and the United States. The powerful Russian MIG-3 and the armored IL-2 or Stormovik, are mentioned particularly. The belief is also advanced that the airplanes now being launched by Hitler against Russia are manned by inexperienced and hastily trained airmen.

When the necessity arose, he points out, the Soviet air force introduced ramming tactics which were hitherto unknown in any other air force. *Aviation*, August, 1942, pages 90–92, 265, 266, 7 illus.

Report from the British Airfront. Myles V. Cave. With individual consideration of each type of airplane, an evaluation is made of American aircraft now in service on the European battle fronts. This is supplemented by a discussion of new military airplane and engine developments. For comparison purposes some British and German planes are mentioned.

Discounting rumors that American airplanes do not come up to specified performance, the writer attributes them to a misunderstanding caused by the fact that British and American

performance figures are quoted on different bases and cannot be compared directly. Americans quote performance data and engine output as maximum figures; the British, on the other hand, quote carrying loads with relative flight range, specify performance figures at given altitudes, etc., while engine powers are quoted on the International Rating Basis. He suggests a standardization through emulation of the British procedure. *Aviation*, August, 1942, pages 191, 193, 195, 4 illus.

Air Power Changes Sea War Strategy. John A. Ward. In support of the thesis that air power is now the main factor determining the outcome of any naval battles, the battles of the Coral Sea and Midway are reported in detail. With regard to the Coral Sea engagement it is affirmed that every ship that was sunk or damaged succumbed to aerial bombs or torpedoes; the maneuvers at Midway, too, are denoted as proof that aircraft carriers precede in importance battleships, cruisers and destroyers. The descriptions of the encounters are said to be based on authoritative statements of what actually transpired. *Aero Digest*, August, 1942, pages 68–71, 242–244, 8 illus.

$??,000,000,000. Statistics indicate that the mass production of finished military airplanes is one of the greatest undertakings in the history of manufacturing. It is requiring hundreds of industries and thousands of plants, thousands of man-hours, thousands of parts. The rate of production of air power for 1942 has never before been dreamed of, but it will be greatly exceeded in 1943. It is estimated in this article that for the output scheduled for 1943, the 1941 facilities will be tripled. Simpler airplanes that can be made more rapidly are forecast. *Western Flying*, July, 1942, pages 34, 35, 2 illus.

Air Transport

Atlantic Ferry. As evidenced by the activity at the main Eastern terminal of the Ferry Command, a summary is presented of the work which goes into the organization and operation of the Atlantic Ferry Service. The coordination of varied experience and knowledge, as well as the cooperation of different Services, military and civil flyers, and tri-country (Canada, United States and Britain) direction are related. Some other special points considered in this article are routes, qualifying of pilots, safety precautions, supply of aircraft, and controlling stations. *The Aeroplane*, June 26, 1942, pages 731–733, 4 illus.

Air Transport Auxiliary. Group Capt. G. W. Williamson. A detailed discussion of the problems of the British Home Ferry Service outlines the functions, origin and organization, personnel, training, and area organization of the Air Transport Auxiliary. It tells how the Air Transport Auxiliary flies and maintains Royal Air Force aircraft in transit, school aircraft for the production of fully qualified pilots, and taxi aircraft to carry pilots to the factories from which they collect and bring operational airplanes home. *Flight*, June 18, 1942, pages 517–521, 18 illus.

Mobility. V. L. Gruberg. Demonstrating the urgent need for air transportation in this war, this article reviews the aircraft being used for transport purposes by Italy, Germany, Russia and the United States. With war fronts spread all over the world, only airplanes can furnish the mobility of supplies and men necessary, it is reported. The assertion is made that the United Nations need a much wider employment of transport aircraft and a numerically strong organization to execute rapid transportation to the various theaters of war when supplies are urgently needed. It is also declared that had these been available during the operations in Burma, developments might have been different. While it is not suggested that airplanes replace shipping exclusively, it is urged that they form at least an equal component of the supply system. *Flight*, July 9, 1942, pages 35–39, 12 illus.

Importance of Weight Control in Airline Operation. Charles Froesch. In a paper previously presented before the Society of Aeronautical Weight Engineers on April 10, the writer analyzes the reasons why the "empty weight" of an airliner increases proportionately to the length of time it operates and describes the improvements in design of aircraft structures and accessories that are being sought by weight engineers to alleviate this condition. Three categoric reasons listed are: weight increases demanded by safety, weight increases to reduce maintenance and weight increases to improve passenger comfort. The procedures regarding factors controlling empty weight and balance are based on those used by Eastern Air Lines. *Aviation*, August, 1942, pages 201, 202, 285, 286, 289, 4 illus.

CAP Courier-Cargo Service Passes Experimental Stage. The duties executed by the New York Wing's First Courier Command are outlined, indicating one of the contributions of the Civil Air Patrol to the war effort. The First Courier Command has been flying key men and materials between war production plants and their branches, subcontractors, air shipping points and testing laboratories. A survey of the Command's operations is stated to show not only a saving in time but also, in some instances, a saving of money. It is also reported that the demand for the service has reached a point where fairly regular schedules can be maintained. *Aviation*, August, 1942, pages 215, 216, 4 illus.

War for the Skies: We Must Ship by Air. In this article the various phases of the application of air transport to the present war are explored. It is indicated that government agencies are planning to increase materially the number of aircraft used for transportation of cargo and troops, possibly diverting some of the present production facilities from bombers and fighters to cargo airplanes. Comparative figures are submitted to show the number and type of aircraft that would be required to transport a given amount of military freight to the theaters of war by comparison with the tonnage that could be moved by ocean freighters.

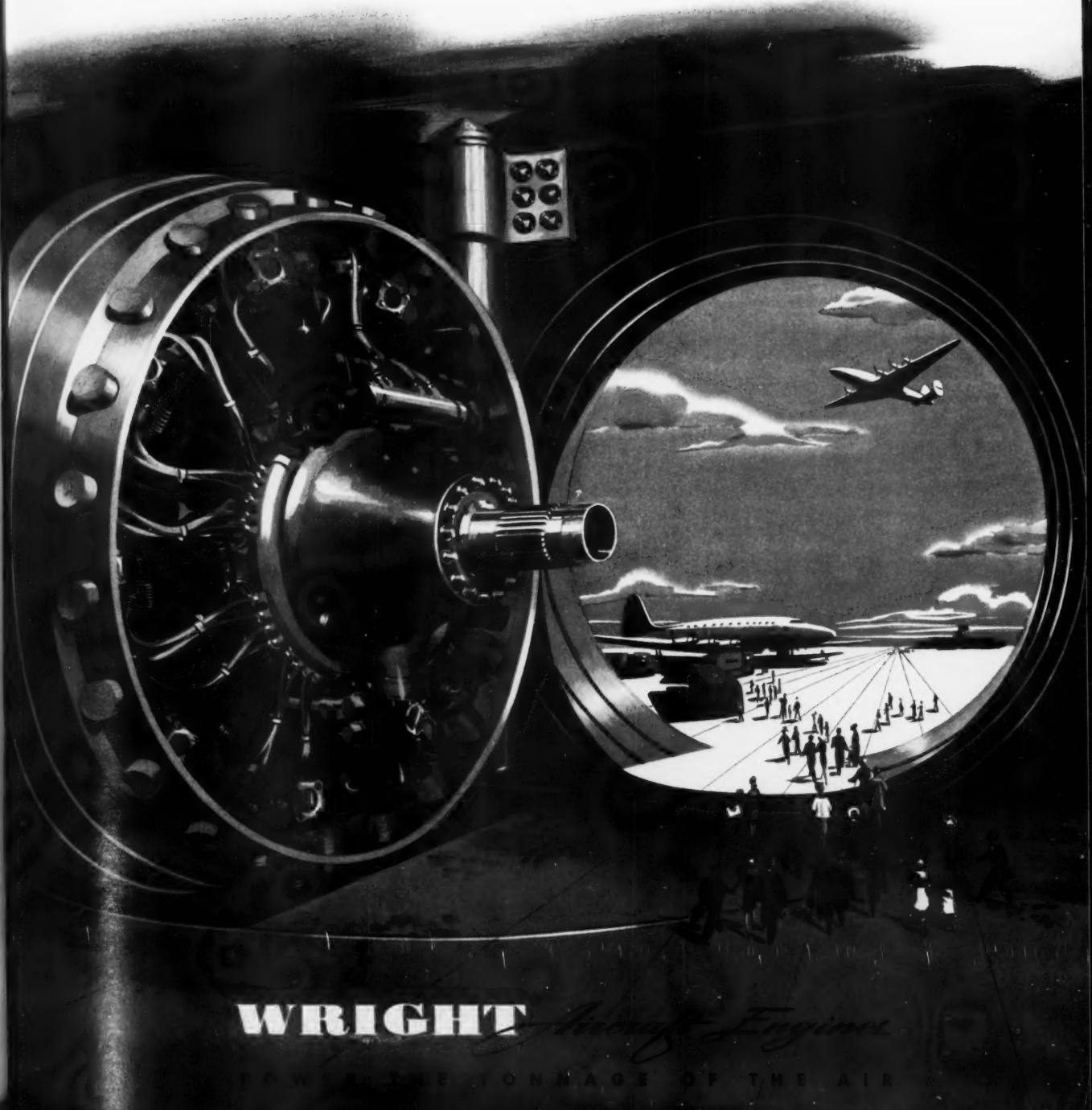
Consideration is given to the disadvantages of the air method of transporting materials and men, these including the immediate production problem and the operational problems, which would be intensified as the number of aircraft carriers increased. The achievements of the Germans in providing air transportation are pointed out as an example of what can be accomplished, information being included on the equipment used by the Germans.

A study is presented of the equipment now available through purchase or other means of acquisition of the existing equipment of commercial air-transport companies. Possible routes for the suggested services are outlined. There are four major ranges that must be spanned to reach American and Allied forces on the presently active fronts, these being from Natal, Brazil, to the west coast of Africa; from Newfoundland to England; from the mainland to Hawaii; and from Alaska to China.

The writer indicates that the Air Forces Ferrying Command, now enlarged into the Air Transport Command could form the nucleus of a world-wide military air-transport serv-

SAFEGUARD *to the present . . .*
GATEWAY *to the future*

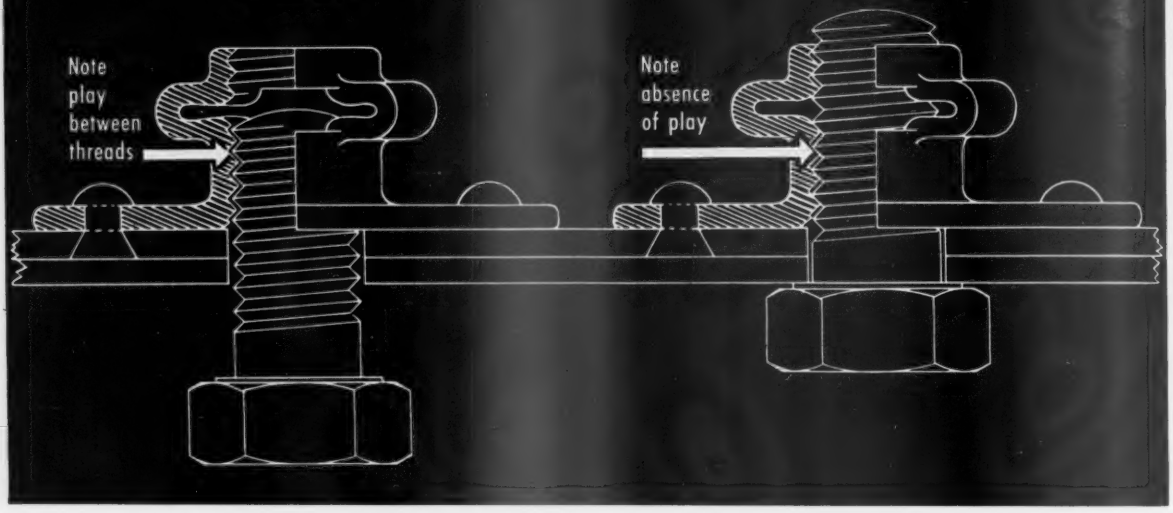
The time-vault, with its flawless mechanism, protects man's most valued material possessions. So also America's powerful precision-built aircraft engines are today safeguarding the values that will make the future secure. As the gateway to tomorrow opens, we see the tonnage loads of commerce going by air—world progress for which Wright provides the power.



WRIGHT *Aeronautical Engines*

NOW IS THE TONNAGE OF THE AIR

HERE'S HOW BOOTS SELF-LOCKING NUTS INSURE VIBRATION-PROOF CONNECTIONS


BEFORE
bolt engages locking section of the nut
Note play between threads
AFTER
bolt engages locking section of the nut
Note absence of play

CONSTANT PRESSURE CONTACT ELIMINATES AXIAL PLAY

The Boots Self-Locking Nut is a one-piece all-metal nut which withstands the severest vibration. Essentially two nuts in one, the top (locking) section is displaced in a downward direction so that its locking threads are out of lead with the load carrying threads of the lower section. The two sections are connected by a spring member, which is an integral part of the nut.

Upon the insertion of a bolt, the spring member, because of its elasticity, allows the top section of the nut to be extended to engage properly with the threads of the bolt. A constant force is thus established which locks the nut firmly into position without damage to the threads of nut or bolt. Axial thread play is eliminated.

BOOTS NUTS SAVE UP TO 60 LBS. PER PLANE, DEPENDING ON MODEL

Consider the weight of the Boots all-metal self-locking nuts when trying to save all-important weight in design. Consider particularly the variety of Boots anchor nuts in which the sheet metal construction allows savings of 18% to 68%—many valuable pounds per airplane directly and indirectly.

In addition to the important and substantial weight-saving characteristic, Boots Nuts have another outstanding advantage: they are all-metal, which means they may be used over and over again with continuing self-locking efficiency. Boots Nuts "Outlast the Plane."

Write for new catalogue today.

There's a BOOTS NUT for every application

BOOTS

BOOTS AIRCRAFT NUT CORPORATION

GENERAL OFFICES, NEW CANAAN, CONNECTICUT

ice. Questions are posed concerning the future of the commercial companies in view of the projected militarization of the commercial lines but such questions are left to be solved after the war, as are other questions concerning the peacetime functions of such an organization as is proposed. *Fortune*, August, 1942, pages 85–89, 158, 160, 162, 164, 166, 5 illus.

Freighters of the Sky. The third phase in the development of air power is held to be the use of aircraft for the transportation of combat forces and supplies to distant battlefields. According to the writer, the first phase was the use of planes in cooperation with ground troops and the fleet, and the second was independent operations back of the enemy lines by bombing industrial and military objectives. Comments are quoted from scientific, industrial and commercial leaders, bearing upon the development of large transport aircraft. The way has been shown by the Air Forces Ferrying Command, whose operations and equipment are described briefly. Forecasts of the air freight operations of the future are made. *Dixie Air News*, July, 1942, pages 12–14, 30, 9 illus.

U.S. Starts Transport Revolution—George. Quotations from statements made by Brig. Gen. Harold George, Commanding General of the Consolidated Air Transport Command of the Army Air Forces, at a press conference are given. General George sees unlimited use for cargo planes and gliders, both now and in the period following the war, and believes this war will provide a greatly increased impetus to air commerce. He discounts criticism regarding the neglect of glider development in this country.

By the absorption of the Army's and other air ferrying and cargo services, the Air Transport Command's route mileage has been increased to nearly double the distance around the world. In his opinion there are no technical limitations to the size of the aircraft. *American Aviation*, July 15, 1942, page 3, 2 illus.

U.S. Studies Mass Cargo Plane Output. David Shawe. Plans proposed by Henry Kaiser, west coast shipbuilder, for producing a large quantity of heavy cargo-carrying airplanes are reviewed. It is stated that an annual production of 5,000 flying boats similar to the Martin Mars could be reached by the shipyards within a period of ten months after the award of contracts. Moreover, the shipbuilder is quoted as saying that production lines could be in operation in less than six months, the only question being the supply of materials. It is indicated that the experience of The Glenn L. Martin Company will be relied upon to a great extent for the design and production of the proposed airplanes. *American Aviation*, August 1, 1942, pages 4, 27, 1 illus.

Douglas four-engine C-54 Army transports. These transports have a cargo capacity equal to that of a standard railroad boxcar.

Mfrs. Will Need Post-War "Service Stations." E. J. Foley. A forecast is provided of the service work that will be necessary upon the resumption of commercial air transport after the war. Service for the equipment will have to be better and service for the public will also need to be greatly improved. The writer suggests that service stations be established by manufacturers at key airports which would provide active personal attention for the problems of the air-line operator. *American Aviation*, August 1, 1942, page 40, 1 illus.

Airlines in the War. R. I. Robinson. The achievements of domestic air lines in transporting air cargo and training pilots under the War Department's plan enabling commercial air lines to participate in the war effort are described. The article includes statements made by Major Gen. Henry J. F. Miller in a letter to the presidents of the air lines regarding the achievements of these companies in the transportation of war supplies and materials. *Airlanes*, July, 1942, pages 2, 3, 23, 5 illus.

100,000,000 Miles of Flying! B. H. Griffith. An account of the contribution Eastern Air Lines is making to the new Army Air Transport Command. How the highly trained pilots of this company—like those of the other commercial air lines—are contributing their efforts to the problem of war transport, is described. Cargoes flown for the Air Transport Command include airplanes, propellers, armament, generators and often technical equipment for new base projects. Air-line experience is aiding in the maintenance of schedules and in efficient packaging to aid in weight reduction. *Airlanes*, July, 1942, pages 12, 13, 20, 5 illus.

What's Over the Horizon in Air Transportation? A digest of opinions on the revolutionary influence of aircraft upon transportation. Glenn L. Martin and Grover Loening are quoted. It is shown how the airplane is assuming a new role as a long-range load-carrier that will not only play a great part in winning the war but will also have far-reaching results on post-war progress. Facts and figures are given to illustrate the advantages of air travel over both land and sea conveyance. Even if an airplane is light and small, it is explained how by virtue of its speed its capacity in ton-miles is greater than other means of transportation.

In discussing the development of large air transports and their almost limitless possibilities, data are presented on several carriers now leading the field. Among these are the Martin Mars, the Curtiss-Wright C-20, and the Douglas B-19. *Canadian Aviation*, July, 1942, pages 19–22, 34, 4 illus.

Wings Over the North. Part I. Pete de Wet. A résumé of northern flight operations which are said to have formed the beginnings of commercial aviation in Canada. This first of a series of articles covers the period from 1914 to 1927. It tells of the early brush pilots, the routes that were pioneered, and some of the companies who sponsored them. Inauguration of forest protection, mineral exploration, aerial reconnaissance, and

topographic mapping services as well as the establishment of passenger freight, and mail service are outlined. *Canadian Aviation*, July, 1942, pages 24–26, 34, 9 illus.

Invisible Bridge. A survey of the development of the Royal Air Force Ferry Command route across the Atlantic from Newfoundland to England. How the Ferry Command was organized, who its pilots are, the planes it flies, and its purpose are all related. The record of the Command in not having a single airplane lost between Newfoundland and Britain is given. *Canadian Air Cadet*, June-July, 1942, pages 16, 17, 19, 9 illus.

Coming: A Merchant Aerine. William M. Sheehan. A study of present-day transportation problems and the feasibility of aerial freighting presents the conclusion that a merchant aerine is a logical successor to the merchant marine. The writer cites the time-saving advantages of air transport over surface methods. He also points out its ability to overcome natural obstacles, such as mountains, and man-made boundaries. In addition to wartime needs, the potentialities of air freight after the war are considered. *Flying and Popular Aviation*, August, 1942, pages 28–30, 72, 4 illus.

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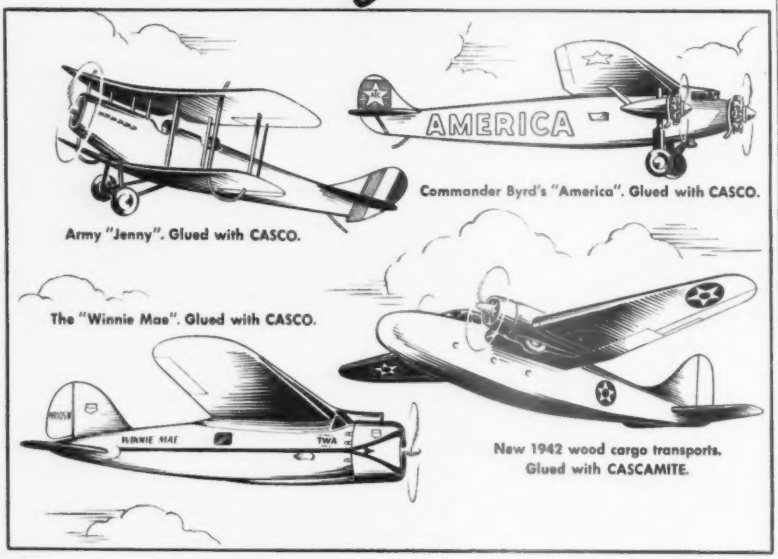
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The Biggest Job Begins. Assignment to the commercial air lines of the task of transporting men and materials to the fighting fronts throughout the world is called the biggest job yet undertaken by those companies. Under the direction of the Army Transport Command wartime routes have been laid out for ten of the major air lines to carry thousands of men and tons of supplies to the distant parts of the world where United States forces are engaged in the war. The trips they will make and the equipment to be supplied to them by the Army are mentioned. In addition, the Army plans to send several thousand men to the air lines' expanded training schools. A few of the recent achievements of the Army Transport Command are reviewed. *Time*, August 3, 1942, page 63; "Army Assigns World Routes; Won't Take Over U.S. Carriers." Robert H. Wood, *American Aviation*, August 1, 1942, pages 1, 18, 4 illus.

Cargo Planes for Victory. Royal B. Lord. The writer urges the use of large cargo planes for ferrying troops and materials to war zones and emphasizes the desirability of employing low-carbon steel for the economical and speedy construction of aircraft for the purpose. The planes must be much larger than any now in the commercial field. For example, the present C-53 cargo plane having a gross weight of 12.5 tons will carry some 2 tons of cargo on a 2,000-mile trip, or about 16 per cent of the gross weight. For shorter distances the ratio may be 25 per cent or higher.

Designs of fighter and bomber planes now are based on the use of aluminum. Plywood is said to be good for trainers, also for some cargo planes, but the writer advises against too great concentration on this material. Avoiding the use of such materials as nickel and chromium, low-carbon steel is offered as the best solution to the problem. Tests show that low-carbon steel entails little weight handicap, has practically no corrosion difficulties and welds easily.

Comments are made on the comparative functions of bombers and cargo airplanes. The article concludes with a discussion of the strategy necessary in bombing German cities. *Popular Science*, September, 1942, pages 66–70, 216, 218, 219, 14 illus.

Clippers at War. It is shown how America's international transport services, including the Pan American Airways System and Northwest Airlines, have been geared to the military effort. Following the attack on Pearl Harbor the war became a war of transoceanic air transport. Fortunately, it is pointed out, the United States Government had at its com-

mand the only transoceanic air transport system that aviation had yet produced. Long-range transport planes, clipper captains and ocean-trained crews were available in a transport system that could be expanded to world-wide dimensions. Within 24 hours of the Pearl Harbor attack all oceanic clippers were being converted into wartime transports.

Because of the curtailment of surface shipping, American republics and allied nations beyond the seas were highly dependent upon air service for communication and transport. Maintenance procedures were developed and air bases operated on a 24-hour basis. As a result of these and other technical advances, flight time was speeded up and schedules increased in order to provide what amounted to double the capacity available for normal peacetime traffic. *Airlanes*, July, 1942, pages 14, 15, 18, 3 illus.; "Our New Life Line to the East," Don Wharton, *Saturday Evening Post*, August 1, 1942, pages 19, 65, 3 illus.

China's Flying Freighters. Edgar Snow. A narrative of the experiences of a war correspondent in flying with the Himalayan ferry, now the main supply line from India to China. This air ferry carries airplane parts, ammunition, gasoline and bombs to Southern Yunnan and Northern Burma and brings back to India tin, tungsten and tung oil. The article gives an eye-witness description of the performance of American planes and pilots in this theater of the war. *Saturday Evening Post*, August 1, 1942, pages 20, 21, 63–65, 3 illus.

Airplane Descriptions

Soviet Military Aeroplanes. James Hay Stevens. It is indicated that early opinions of Russian aircraft held outside that country were inaccurate and that progress has been steadily maintained in their design and construction. Exact information about Soviet aircraft is difficult to obtain, but available data indicate that there has been substantial improvement in design since 1939. This article proceeds to describe numerous types of Russian aircraft, including bombers, of which the mainstay is said to be the three basic types known as the SB-2, the DB-3 and the PE-2, to which are added types SB-3 and DB-3F, which are variants of the first two types. Details of the SB-2 and SB-3 are presented, including their construction, armament, engines and propellers. Similar descriptions are given of the DB-3 and DB-3F, as well as the type PE-2.

For ground attack and Army cooperation the Soviet air fleet uses several aircraft. These specified types include reconnaissance, artillery observation, ground attack and dive-bombing airplanes. Details are reported on the type IL-2, known as the Stormovik, the single-seater dive bomber that has achieved considerable success. The type YAK-4 is generally similar in appearance but differs materially in construction and detail, and information is given on these details. Another type in this classification is the SU-2, a two-seater general purpose monoplane.

Among the single-seater fighter types are the I-15 MK-III, which is included only because of its retractable undercarriage; the MIG-3, a low-wing monoplane of mixed construction; and the YAK-I. Several seaplane types are also mentioned briefly. Among the conclusions, it is stated that Russia has made a successful compromise with some of the difficult conditions that arose through political ideas and labor situations. The adoption of automatic machinery has helped to alleviate the labor problem. It is stated that the authorities have concentrated on a few basic types of military airplanes which have some distinct features but are generally of sound aerodynamic design. The figures and information in this article are derived from enemy sources, and due allowance should be made for difficulties in translating from the Russian. *Aircraft Engineering*, June, 1942, pages 152–159, 25 illus.

A New Russian Bomber. A short description of an unidentified type of Russian bomber which recently carried M. Molotov to Great Britain and the United States. The two photographs shown are stated to be the only ones yet available for publication. The plane is described as obviously the modern development of the four-engined monoplane bomber designed by A. N. Toupolev some 15 years ago. It is believed to be a "cleaned-up" version of the TB-6, which was the latest four-engined Russian type before this plane became known. The modern stressed-skin type of construction is used. Power is believed to be furnished by M-34 or M-35 twelve-cylinder liquid-cooled engines. There is a globular twin-gun, power-operated turret in the nose with other gun positions in the tail and in the rear of the inboard engine nacelles. *Aircraft Engineering*, July, 1942, page 197, 3 illus.

There Are New "Stars" in the Russian Skies Where Soviet Airmen Blast the Axis Hopes. Brief detail on some of the latest Russian aircraft. The airplane models developed in the past year are said to excel greatly the earlier types in speed, performance and striking power. They include fighters, ground attack and dive bombers, light reconnaissance bombers, and seaplanes. A table of the principal operational types in the Soviet air fleet is also shown. *Commercial Aviation*, July, 1942, pages 27, 28, 2 illus.

El Avion Ruso de Caza 1-16B "Rata" (The Russian Fighter Plane I-16B "Rata"). H. J. Cooper. A description is presented of a Russian fighting airplane that is said to be the smallest of its kind ever built. It is reported that the airplane was used first in 1937 under the name of Mosca by the Republican air forces during the Spanish Civil War. Some information has been revealed showing that the airplane has a speed of between 400 and 500 kilometers per hour and that it is extremely maneuverable. The appearance of the aircraft is something like the Boeing P-26, being a small, strongly constructed low-wing monoplane. The latest model is equipped with a double-row Wright Cyclone engine developing over 1,000 hp. and having a two-bladed metal propeller. The original engine was a 660-hp. radial derived from the Wright Cyclone. The armament is reported to vary according to different types but generally consists of four machine guns—two, 30 mm., above the engine cowl, and two, 50 mm., in the wings.

Constructional data are as follows: span 9.50 m., length 6.68 m., height 3.15 m., wing area 13.158 sq. m. Empty weight is 2,229.14 kg.; flying weight, 2,769.4 kg. Performance: Rata I-16 maximum speed 445 km. per hour; rate of climb to 5,000 m., $6\frac{1}{2}$ min.; service ceiling 9,590 m.; cruising range, 800 km. Rata I-16B, maximum speed, 464 km. per hour; cruising speed at altitude of 4,000 m., 352 km. per hour. Rata I-16C, maximum speed, 480 km. per hour; cruising range, 800 km. *Mundo Aeronautico*, April, 1942, pages 37, 38, 1 illus.

But Will It Fly? This One Did! From British sources information is published on an asymmetric airplane developed by the Germans—the Blohm and Voss BV 141. This is a two-place, low-wing reconnaissance monoplane, powered by a 1,000-hp. Bramo Fafnir radial engine. Its dimensions are given and comments are made on the design and construction of the airplane. Certain advantages

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are conceded in range of vision and freedom from vibration for the crew permitting better shooting or photographing. Examination indicates that the lifting surface outboard of the center section carrying the engine fuselage and crew nacelle is about equal. *Air News*, August, 1942, pages 4, 39, 3 illus.

Aircraft Types and Their Characteristics. Third in a series of articles describing different types of airplanes, their specifications and dimensions, this is devoted to two fighters—the Bell Airacobra and the Grumman Martlet 1. The former is a single-seater monoplane with its engine, an Allison twelve-cylinder in-line liquid-cooled unit, set amidships in the fuselage. It has a reported top speed of 358 m.p.h., a service ceiling of 35,000 ft., and a range of 1,098 miles. The Airacobra has a tricycle undercarriage, a feature that is unique for a single-seater fighter.

The Martlet 1 is an export version of the Grumman-built United States Navy Airplane F4F-3 with modifications to suit British requirements. Also a single-seater monoplane, it is powered by a Wright Cyclone nine-cylinder air-cooled radial engine. This fighter has a top speed of 325 m.p.h. and a cruising speed of 285 m.p.h.; its service ceiling is 28,000 ft.; and its range at cruising speed is 1,150 miles.

Fourth of the recognition series of articles covers the Heinkel He 111K and Junkers Ju 88 bombers. The development of the Heinkel from a German commercial type is traced. It is stated that the current Mark V is powered with two Daimler-Benz DB 601A, each giving a maximum of 1,150 hp. at 2,400 r.p.m. A variation is the Mark VA with Junkers Jumo engines of 1,200 hp. The performance of these is mentioned and construction details are given.

It is stated that the Junkers Ju 88 is probably the most aggressive-looking German fighting machine. Its features are described, including the Jumo engines of 1,200 hp. each.

The fifth article gives descriptions of the Douglas DB-7B and the Hudson V which include specifications, dimensions, performance and armament figures, and diagrammatic illustrations of these two bombers. Although the DB-7B—or Boston 111, as it is known in Britain—incorporates several modifications, it is basically similar to its predecessor, the DB-7A or the Havoc 11. Its Wright 14-cylinder, double-row Cyclone air-cooled radial engines are of the GR-2600 type. They yield 1,275 hp. at 2,300 r.p.m. at 12,000 ft., with 1,600 hp. at 2,400 r.p.m. for take-off. The chief structural differences between the DB-7B and its predecessors are: a longer nose section, an increased fin and rudder area, and nacelles that extend still further behind the trailing edge of the wings.

The latest four-engine Boeing Flying Fortress.

The latest type of Lockheed Hudson bomber, the V, embodies improvements over the earlier models. It is fitted with two Wright Cyclone GR-1820-G205a air-cooled radial engines, each giving 900 hp. at 14,000 ft. and 1,200 hp. at 2,500 r.p.m. for take-off. The Hudson V's top speed is 284 m.p.h., its cruising speed 255 m.p.h.; its service ceiling is 22,000 ft. and its range at cruising speed 2,160 miles. Although the normal loaded weight of this bomber is 17,500 lbs., its maximum overload capacity is 2,000 lbs. with a disposable load of 5,694 lbs. *Flight*, June 25, 1942, pages 640a, 640b, 2 illus.; June 2, 1942, pages 12a, 12b, 2 illus.; July 9, 1942, pages 40a, 40b, 2 illus.

The Short Stirling Heavy Bomber. Drawings showing constructional details of the British Short Stirling bomber, furnished by *Aircraft Engineering* (England). These illustrate the design of the various major parts of this heavy bomber which can carry a bomb load of 8 tons and is powered with four 1,600-hp. sleeve-valve engines. *Automotive and Aviation Industries*, July 15, 1942, pages 30–33, 12 illus.

Aeroplanes of the Japanese Army and Navy Air Forces. Further information appears on the type, crew, armament, dimensions, weight, and performance of several types of Japanese airplanes. Drawings illustrate each model. *The Aeroplane*, June 26, 1942, page 730, 6 illus.; July 3, 1942, page 21, 6 illus.; July 10, 1942, page 54, 6 illus.

The Dornier 217.E. A detailed description of the Dornier Do 217E, used by the Germans as both an ordinary bomber and a dive bomber. A high-wing monoplane of all-metal construction, the Dornier Do 217E is powered by two BMW 801 engines. It is a development from the Dornier Do 17 and Do 215 but differs from its predecessors in several structural, aerodynamic and engine-installation respects.

Special characteristics of the 217E which are featured in this article are its unusual dive-brake arrangement, slotted fins, and the close-fitting cowl housing of its fan-cooled engines. Observations are also made on its electrical tail trimmer, wooden airscrew blades, oil cooling arrangements, bomb beam details, deicing equipment, and controls. *Flight*, June 25, 1942, pages 635–639, 13 illus.; *The Aeroplane*, June 26, 1942, pages 734–736, 9 illus.

Bermuda-Buccaneer. The Brewster Buccaneer dive bomber, called the Brewster Bermuda by the Royal Air Force, is briefly described. Originally developed for the United States Navy for operation from the decks of aircraft carriers the export version is designed for operation from land bases. This all-metal, mid-wing monoplane is powered by a Wright double-row 14-cylinder engine rated at 1,700 hp. and equipped with a Curtiss electric airscrew fitted with cuffs and a

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spinner. A feature of its design is the provision for carrying a 1,000-lb. bomb entirely within the fuselage. Eliminating the high drag of an exposed rack and bomb, this is said to make the Bermuda-Buccaneer 100 m.p.h. faster than either the German Stuka or other American dive bombers now in use. It is also claimed that this airplane has double the load-carrying capacity and range of the Stuka. *Flight*, June 18, 1942, page 622, 1 illus.

North American "Mitchell" B.25C. Photographs and a general-arrangement drawing accompany a brief description of the North American Mitchell, twin-engined medium attack bomber. This bomber has a tricycle undercarriage and twin fins and rudders. Its engines are Wright G.R.-2600-5AB double-row Cyclones of 1,700 hp. fitted with Holley carbureters. *Flight*, July 9, 1942, page 40, 3 illus.

Avro Lancaster. A series of pictures illustrates the Avro Lancaster, four-engined development of the Avro Manchester. Its engines are Rolls-Royce Merlins carried in underslung nacelles, with three-bladed constant-speed airscrews fitted. Features of this bomber include nose, tail, and dorsal gun turrets on the lines of the Stirling and Halifax bombers. *Flight*, July 9, 1942, pages 32, 33, 6 illus.

Handley Page Halifax. Part 2. Wilfred E. Goff. This installment covers the building of the nose, rear and tail sections of the fuselage. Details are given on the internal construction and the methods by which these parts are built. The tail fuselage section is regarded as an outstanding example of out-of-jig assembly. On the finishing line equipment and services are installed. Details of the construction of the tail plane follow, with information on the fixtures used, and similar treatment is reported for the fin and elevator rudder.

The article concludes with information on the assembly of the complete unit, engines and mountings, and the final assembly operations. *Aircraft Production*, July, 1942, pages 452-464, 42 illus.; Handley Page "Halifax," *Aviation*, August, 1942, pages 211, 269, 2 illus.; *Canadian Air Cadet*, June-July, 1942, page 8, 3 illus.

Germany's New Dornier 217E Warplane. M. W. Bourdon. The first of two articles on the Dornier Do 217E-1 multiple-purpose bomber based on a report issued by the British Ministry of Aircraft Construction. This high-wing monoplane with two double-row 14-cylinder engines resembles in many respects the earlier Do 17Z, but, in addition to a greater wing span, there are a number of

changes, one of which is in the design of the twin fins and rudder. General features of design are incorporated in this article, including wing and fuselage construction and important engine specifications. A table of aerodynamic data covering the wings, flaps, longitudinal, directional and lateral controls is furnished. The second part of this article will appear in a forthcoming issue. *Automotive and Aviation Industries*, July 15, 1942, pages 18–22, 9 illus.; August 1, 1942, pages 34–39, 11 illus.

Airports

Willow Run Airport. Franklin M. Reck. Data are given on the construction of the airport adjoining the Ford Willow Run bomber plant with special attention to the size of the airport, the problems it posed, and the speed with which it was completed. The first problem—that of speed—necessitated the simultaneous carrying out of all operations—grading, laying sewer pipe, paving, etc. The second problem was the high water level, which called for a highly efficient drainage system to avoid frost heaving, buckled paving, and standing water. The third problem concerned the task of conditioning the subgrade for the runways.

The airport is credited with incorporating all possible features of modern construction. Among those commented upon are its equipment for handling a crash landing anywhere within a radius of 150 miles, the complete lighting of the field, and its situation from a safety point of view. *Aero Digest*, August, 1942, pages 88, 90, 93, 217, 8 illus.

Airport Lighting System Control. W. C. Norvell. A brief outline of a precision-controlled airport lighting system includes an explanation of its importance. The nucleus of this control is the observation tower panel, which consolidates the responsibility for efficient overall operation. Contained in the panel are wind indicating instruments, a miniature facsimile of the field with pilot lights to indicate lighted runways, selector switches that can be lined up with the wind direction indicators and runways for control of contact lights, dimming control for field contact lights, a master switch for full emergency lighting of the field, and circuit breakers for all miscellaneous field lighting circuits. *Aviation*, August, 1942, page 205, 2 illus.

'Flight Strips.' Col. Stedman Shumway Hanks. Structureless areas for the landing and take-off of aircraft, flight strips, it is claimed, offer an immediate answer to our urgent need for more airplane landing sites. This is a progress report on what is being done in the development of a sound program for the building of flight strips. It discusses appropriations, agencies involved, costs, etc. It also tells the requirements for the construction of flight strips and the purposes they serve. In addition to their military value, their influence on air cargo transportation is indicated. *Flying and Popular Aviation*, August, 1942, pages 25, 26, 90, 92, 5 illus.

Steel Airport. George R. Reiss. Details of portable steel runways and how the obstacle to their successful construction was removed by an idea contributed by Gerald G. Greulich, steel specialty engineer. Greulich's idea is based upon hundreds of steel planks, each 10 ft. long, 15 in. wide, 1/4 in. thick and weighing 65 lbs., joined with sliding interlocking projections on one panel which fit into slots on the next. Simple little pins lock these into place, to keep the planks from coming apart under the pounding wheels of heavy airplanes.

The article depicts the ease with which these portable airports can be constructed, repaired and transferred. They are also said to lend themselves easily to camouflage. In addition to their military feasibility, the peacetime possibilities of these steel runways are noted. Comment is made that they may provide an important new market for excess steel production capacity. *Flying and Popular Aviation*, August. 1942, pages 45, 46, 3 illus.

Armament

The Weapons of Air Warfare—III. Peter W. Brooks. Following earlier articles that traced the evolution of the machine gun as an air weapon, this third installment of a series on airplane armament relates how machine guns were adapted for air combat early in the war of 1914–1918. Defensive guns, as well as fixed forward-firing installations, are covered. *The Aeroplane*, June 19, 1942, pages 698, 699, 8 illus.

The Weapons of Air Warfare—IV. Peter Brooks. The fourth of this series of articles on airplane armament is devoted to gun mountings. It treats briefly of the period of development from manually operated turrets to power-operated turrets. Progress in gunner protection is also commented upon. *The Aeroplane*, June 26, 1942, page 723, 5 illus.

The Weapons of Air Warfare—V. Peter Brooks. The evolution of the fixed gun, particularly as mounted on the single-seater fighter, is traced from 1916. Experiments with semi-automatic, automatic, and shell-firing guns are recounted. The increase of fire power is noted beginning in 1930, details being given on the Vickers Lewis and Browning guns. The firing power of present aircraft is contrasted with the best performances achieved in 1915. *The Aeroplane*, July 3, 1942, pages 11, 12, 8 illus.

The Weapons of Air Warfare—VI. Peter Brooks. This installment of a series of articles on the development of armament in aircraft deals with the evolution of the multigun turret, the use of servo-feed motors to supply ammunition to turret guns from magazines some distance away, the remotely controlled gun, and various types of gun sights. The advantages of these devices are cited and examples are given of airplanes that incorporate them, while the general trend of armament progress is indicated. The history concludes that—with the exception of the development of the first interrupter gear, of certain early French hand-operated turrets, and of the German and French introduction of mixed cannon and machine-gun armament in fighters—Great Britain has led the way with each new development in aircraft armament. *The Aeroplane*, July 10, 1942, pages 44, 45, 7 illus.

Naval Defence. C. Duckham. Aerial "height charges" are advocated to ward off air attacks at sea. After a brief discussion of present anti-aircraft weapons, the article suggests that for naval defense they be replaced with guns of maximum caliber (15, 18 or 20 in., if possible) for employment against high-flying aircraft, and a short-barrelled cross-bred weapon, between a gun and a mortar, for use against dive bombers and torpedo bombers. It is not deemed necessary for the extreme range in the latter case to be more than 4,000 yards. The projectile in each case would have the thinnest walls possible, consistent with safety, to accommodate a maximum amount of high explosive.

It is claimed that these aerial height charges can be employed effectively against mass or pattern bombing in daylight by a formation of aircraft, dive-bombing or low horizontal-bombing attacks, and air-launched torpedoes. The writer also considers briefly the circumstances under which this form of defense weapon might be used on land. *Flight*, June, 18, 1942, page 616.

Avigation

Astral Aircraft Navigation. Prof. J. W. Melson. The third of a series of articles on aerial navigation refers to spherical trigonometry. The writer analyzes a typical problem and shows that it could be solved by the use of tables, but he suggests that the student should be able to solve it in the

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"hard way" by the use of the formula. He explains the "haversine formula" and the calculations in which it is used. He also explains Napier's rules for circular parts and applies the formulas in the solution of a practical example requiring the finding of the altitude and azimuth of the star Arcturus at a given date and time at a given position of longitude and latitude. Another method, longer than that by the haversine formula but more general, is also outlined. *Canadian Aviation*, July, 1942, pages 27–30, 56, 58, 9 illus.

Air Age Geography. The history of the study of geography is reviewed, reference being made to the development of map making and the various projections upon which maps are drawn. It is shown that a new kind of geography has been created by aviation and must take its place beside the geography and psychology based upon oceans and land. The writer asks for the inclusion of this new conception in the educational systems of the future so that this nation in particular and the world in general may be taught to think in terms of the ocean of air as well as the oceans of water which have previously been the principal avenues of international communication. *Model Airplane News*, September, 1942, pages 6, 7, 52, 53, 3 illus.

Business and Finance

Aircraft Production and Incentives. Selig Altschul. Forecasting that the goals of 60,000 airplanes this year and 125,000 in 1943 will be attained and possibly exceeded, it is shown that aircraft production has increased more than 1,000 per cent in the past two years. This is hailed as an industrial accomplishment of a rare order for which full credit should be given to the established manufacturers of airplanes and engines. Lieutenant General Arnold is quoted to the effect that aircraft factories supplying the Army will produce in 1942 and 1943 at least 148,000 airplanes for the Army alone. It is stated that the aircraft industry is assigned the major part of the new appropriation for military supplies for the fiscal year beginning July 1, 1942, since it has been allotted the amount of $11,300,000,000 out of the total appropriation of $42,800,000,000.

Consideration is given to the economic principles involved in the operations of the industry when the profit incentive has been practically removed through taxation and the voluntary reduction of profits by the aircraft companies through renegotiation of contracts. The writer holds that the desire to serve the nation in its war emergency is an important incentive.

Fixed-price contracts are discussed in the light of questions concerning wages and hours. Tabulations show average earnings and hours worked in the aircraft industry compared with other industries. Effects of estimated taxes and postwar tax credits are also set forth in text and tables. *Aviation*, August, 1942, pages 188, 256, 259.

The irregularity of receipt of publications from abroad necessitates the review of articles in issues several months late. This is done to provide readers with information regarding foreign technical progress as soon as the issues are available in the United States.

Vinson Report Shows Low Aviation Profits. Statistics are taken from the Supplemental Report of the House Naval Affairs Committee showing the number of contracts for aircraft and parts, the amount involved, the profit and percentage of profit. Reductions made in numerous existing contracts are also quoted. The progress made in filling contracts is summarized and praise is given for the accomplishments recorded to date. Figures are also given on plant expansion and new training facilities. *American Aviation*, August 1, 1942, page 6, 1 illus.

Civil Aviation

Civil Aviation in Wartime Canada. A report of an address given by C. H. Dickins, Vice-President of Canadian Pacific Air Lines, at Montreal on April 29, 1942. Mr. Dickins cites the contributions to military aviation by civil aviation, both currently and as a foundation upon which the present war effort is built. He outlines briefly the growth of commercial aviation from the last war to the present day and predicts its further expansion after this war, especially in the field of transoceanic service. Although his discussion includes general comments on air transport and touches upon phases of it in the United States, the writer is mainly concerned with its development as affecting Canada. *The Aeroplane*, June 19, 1942, pages 694, 695, 3 illus.

CAP Formation Flying. Ralph Starkweather. Rules are suggested for formation flying for Civil Air Patrol missions, by a C.A.P. pilot whose early experience in formation flying was gained in the United States and in France as an air officer in the first World War. Variations are made from Army practice to conform to the special characteristics of civilian aircraft. Procedures are given for takeoff, landing, V formation, echelon formation and for changing leadership. *Yankee Pilot*, July, 1942, pages 4, 5, 22, 3 illus.

If There's a Crash. Excerpts are quoted from Civil Air Patrol Directive Number 8, covering instructions for the conservation of life and equipment in the event of accident. Information is presented on organization, preparation, fire extinguishing, crash equipment and procedure. *Yankee Pilot*, July, 1942, pages 12, 13.

Design

Tricycle Landing Gear Design—Part 1. E. S. Jenkins and A. F. Donovan. In Part 1 of this paper the problems of the tricycle landing gear are discussed in the light of available information with the object of providing criteria to assist the designer. The general geometric arrangement involving the determination of wheel base, tread, and center of gravity location is first considered. It is shown that the nose wheel should be located as far forward of the center of gravity as possible, and that the fore-and-aft location of the rear wheels is limited to a narrow range by conditions of balance and longitudinal stability. The relationship between tread, wheel base, and the resistance to turning over is found, and the effects of tread and fore-and-aft location of the rear wheels on the directional stability and ground maneuverability are discussed. *Journal of the Aeronautical Sciences*, August, 1942, pages 385–396, 10 illus.

Fuel Feed at High Altitude. W. H. Curtis and R. R. Curtis. Fuel feeding failures at high altitudes invariably are due to vapor forming in some part of the system between the fuel tank and the carburetor. Such failures may be overcome by preventing the formation of vapor or, if this is impossible, by removing it from the system. Conditions that bring about fuel failures are covered, and means of exploring them experimentally in advance of manufacture are described. The increasingly rapid development of military aircraft has added difficulties to the problem of reliable fuel feed. Variables that affect the fuel in flights to high altitudes include dissolved air, vapor pressure, fuel temperature, turbulence, velocity of fuel, rate of climb, altitude, vent-line effects, and heat transfer. A descrip-

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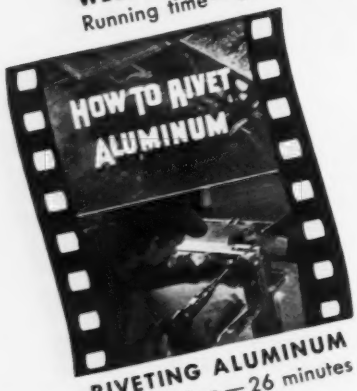

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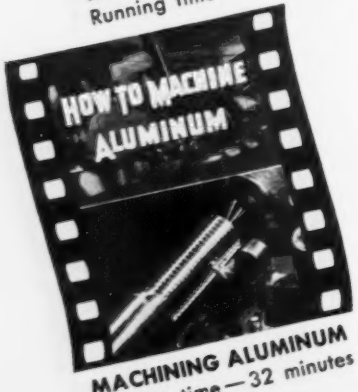

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tion of simulation-test equipment is furnished with numerous illustrations, and simulation-test procedure is specified. The second section of the paper gives detailed results of three series of tests on centrifugal booster pumps. One of these test series is on an isolated tank of fuel and the other two are on the booster fuel system. *S.A.E. Journal*, August, 1942, pages 321–337, 50 illus.

Progress in Structural Design Through Strain-Gage Technique. C. R. Strang. Application of electrical resistance strain-gauge apparatus to problems of structural design is treated. Following a brief description of the equipment, special arrangements of strain-gauge units for each type of stress are discussed. Application of the methods to a number of typical problems shows the means by which more precise design can be accomplished. It is claimed that, with the knowledge so gained, simplification of aircraft structure and hence of production problems can be accomplished. Discussion is largely concentrated on static proof tests or flight tests, but laboratory applications connected with the development of structural theory are touched on briefly. *S.A.E. Journal*, August, 1942, pages 346–357, 19 illus.

Aircraft Types and Their Characteristics. Dimensions, specifications and armament are included in descriptions of two German bombers, the Heinkel He 11K and the Junkers Ju 88. The current Mark V type of Heinkel 111K is powered by two Daimler-Benz DB 601A engines of 1,150-hp. maximum output each. It has a reported top speed of 274 m.p.h. and a cruising speed of 230 m.p.h.

Used for normal bombing as well as dive bombing, the Junkers Ju 88 has two Jumo 211 engines of 1,200 hp. each. Although they are twelve-cylinder, in-line units, the circular nose radiators of these engines give them the appearance of radial installations. The top speed of the Junkers Ju 88 (without external bombs) is given as 281 m.p.h.; its cruising speed is 264 m.p.h.; its diving speed with brakes is up to 340 m.p.h. and without brakes it is over 400 m.p.h. A special feature on the latest A-6 model of this bomber is an automatic device for pulling out of a bomb dive and closing the dive brakes at the right moment in relation to the release of the bombs by pressing a single button. *Flight*, July 2, 1942, pages 12a, 12b, 2 illus.

Evolution of the German Fighter. V. L. G. This article traces the development of the German fighter airplane from experiments around the period 1928–1929 to the recent appearance of the Focke-Wulf FW 190, most advanced German design in this field. Heinkel, Arado, Messerschmitt, and Focke-Wulf fighters are discussed and the transition from biplanes to monoplanes with retractable undercarriage is recorded. *Flight*, July 2, 1942, pages 11, 12, 5 illus.

Cabins for Crews. C. M. Poulsen. An account of two Avro airplanes produced in 1912 which were pioneers in enclosed aircraft types—one a monoplane, the other a biplane. The latter is reported to have been the first aircraft to go into a spin and out again without damage to itself or its crew. A desperate pilot's accidental putting on of the "opposite rudder" is offered as the explanation of the recovery maneuver. *Flight*, June 18, 1942, pages 609, 610, 4 illus.

Aircraft Types and Their Characteristics. Description and specifications of the Curtiss P-40D and the Westland Whirlwind. The Curtiss plane, known in England as the Kittyhawk, is compared with its predecessor, the Curtiss P-40, Tomahawk. Powered with the same type of 1,000-hp. Allison V-1710 engine, the Kittyhawk has a more massive radiator, larger spinner, and all its guns are in its wings.

Designed as a day and night fighter, the Westland Whirlwind is a high-performance twin-engined aircraft powered by two Rolls-Royce Peregrine engines. Two features characterize it: the placing of the high-aspect ratio cantilever tail plane near the apex of the tail fin, and the comparative bulk of the two underslung engine nacelles compared with the slim fuselage sitting on the wide, flat center section of the low wing. *Flight*, June 18, 1942, pages 614a, 614b, 2 illus.

Method of Development for Tapered Wings. Peyton Autry. Preliminary design of an airplane having tapered wing planform involves a determination of the wing contours to be used for various purposes dependent upon the design, such as clearance layouts for landing gear and retracting wells, fuel and oil tank spaces, guns, ammunition and bomb loads, for ailerons and flaps, and for other wing layout plans. Instead of the common practice of developing the sections by lofting procedure, a method is suggested which can be adopted in the early period of design work. It consists of calculating and tabulating stations and section ordinates, which may be applied later in the engineering stage for making full-size templates. These may be rapidly and accurately drawn directly from the calculated tabulations. The mathematical process for working out these calculations is explained and examples are given. *Aero Digest*, August, 1942, pages 136, 139, 3 illus.

A Discussion of Diehl's Static Stability Coefficient. Max M. Munk. The suggestion is made that engineers now entering the aeronautical industry give special attention and intensive study to Diehl's static stability coefficient k. This is regarded as a basic rule upon which the design of practically every modern aircraft has to some extent been based. The writer submits analytical comment and inquires into the significance of the theory with a view toward enhancing the popularity and usefulness of its meaning to make its application more certain. The rule is then explained with emphasis on the importance of static stability, methods of computing the moment coefficient and the moment slope curve. Flight path lengths and elevator response are discussed and the article concludes with applications of the rule. *Aero Digest*, August, 1942, pages 154, 236, 237.

Requisitos Tacticos para el Diseño de Aviones de Caza (Tactical Requirements for the Design of Fighter Planes). A detailed description is reprinted from the Russian publication *Ingeneria Aeronautica* of a number of the well-known fighter airplanes of England, Germany and the United States, after which general conclusions are drawn in connection with the design of this type of aircraft. Among these is the statement that each particular type should be designed according to the part it is required to perform in aerial warfare. Other considerations should be purely secondary. The writer classifies airplanes under several headings, including monoplanes, biplanes, hydroplanes, and subdivides the classifications into such groups as single-place monoplanes with single engines located in front and in the rear and with tractor-type and pusher-type propellers; multiplace, single-engined and multiengined aircraft; airplanes for the single purpose of fighting and for more than a single application; and various other types.

It is stated that studies should be made at the end of an air battle to determine ways in which the plane could be improved. It is also necessary to investigate improvements that could be made in the construction of the airplane, such as the addition of flaps and other equipment, so as to obtain a combination of the characteristics of maneuverability and high speed. Furthermore, a study should be made of the adaptation of actual fighter types of planes for night flights and for flights in the substratosphere. *Aeronautica*, June, 1942, pages 6–9, 3 illus.

The Correction of Engine Output

to Standard Conditions. Donald S. Hersey. In order to provide a common basis for the comparison of high-performance supercharged aircraft engines, formulas are proposed for correcting the measured output to standard atmospheric conditions.

An investigation of power-correction formulas is needed because the formulas generally used were developed for naturally aspirated engines and have been found inaccurate when applied to supercharged-engine test data.

In the development of the proposed correction formulas, the theoretic effects of atmospheric changes on the performance of an engine's induction system units are discussed and applied in a general basic correction formula. These effects pertaining to each induction system unit are checked by comparing the unit formula with test data obtained on a specific engine.

Two engine-output correction formulas, covering both full-throttle and part-throttle operation of single-stage supercharged engines, are evolved. The accuracy of these formulas is determined by comparison of calculated engine performance with flight test data taken under various atmospheric conditions. A similar check of the correction formulas generally used is also made.

A comparison of the old and new full-throttle formulas indicates that former correction errors of as much as 10 per cent may now be reduced to approximately $1^1/_2$ per cent. Comparison of the part-throttle correction formulas shows that the accuracy of the rational formula is slightly inferior to that of the generally used formula.

Correction formulas for two-stage supercharged engines of the gear-driven and turbo-driven variety are finally proposed for consideration, but no flight test proof of these latter formulas is presented.

The conclusions reached as a result of the correction formula investigations are:

1. The formula derived for use in correcting the full-throttle output of single-stage supercharged engines is basically more sound and considerably more accurate than the generally used full-throttle power correction formula.

2. The rational formula derived for use in correcting the part-throttle output of single-stage supercharged engines shows no superiority over the empirical part-throttle correction formula now in general use.

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Heat Conditions in Bearings. Mayo D. Hersey. This paper reviews briefly the older and newer research problems in the field of temperature relations in bearings. It is stated that experimental data on the overall heat-transfer constants that govern the relation of power loss to temperature rise in oil-film bearings are needed. Further investigation should also be made of the effect of oil flow on load capacity, while better methods of measuring oil-film temperature would be helpful.

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Torque on Engine Mountings. C. D. Graham and N. R. Tembe. The high-powered engines of modern airplanes, frequently used in conjunction with large-diameter airscrews and low-reduction gear ratios, cause high torque loads on the mountings. Distribution of these torque loads must be found accurately since they affect the efficiency of the final design. An analytic method of determining the distribution which has been found both accurate and convenient is presented. *Aircraft Engineering*, June, 1942, pages 162, 163, 3 illus.

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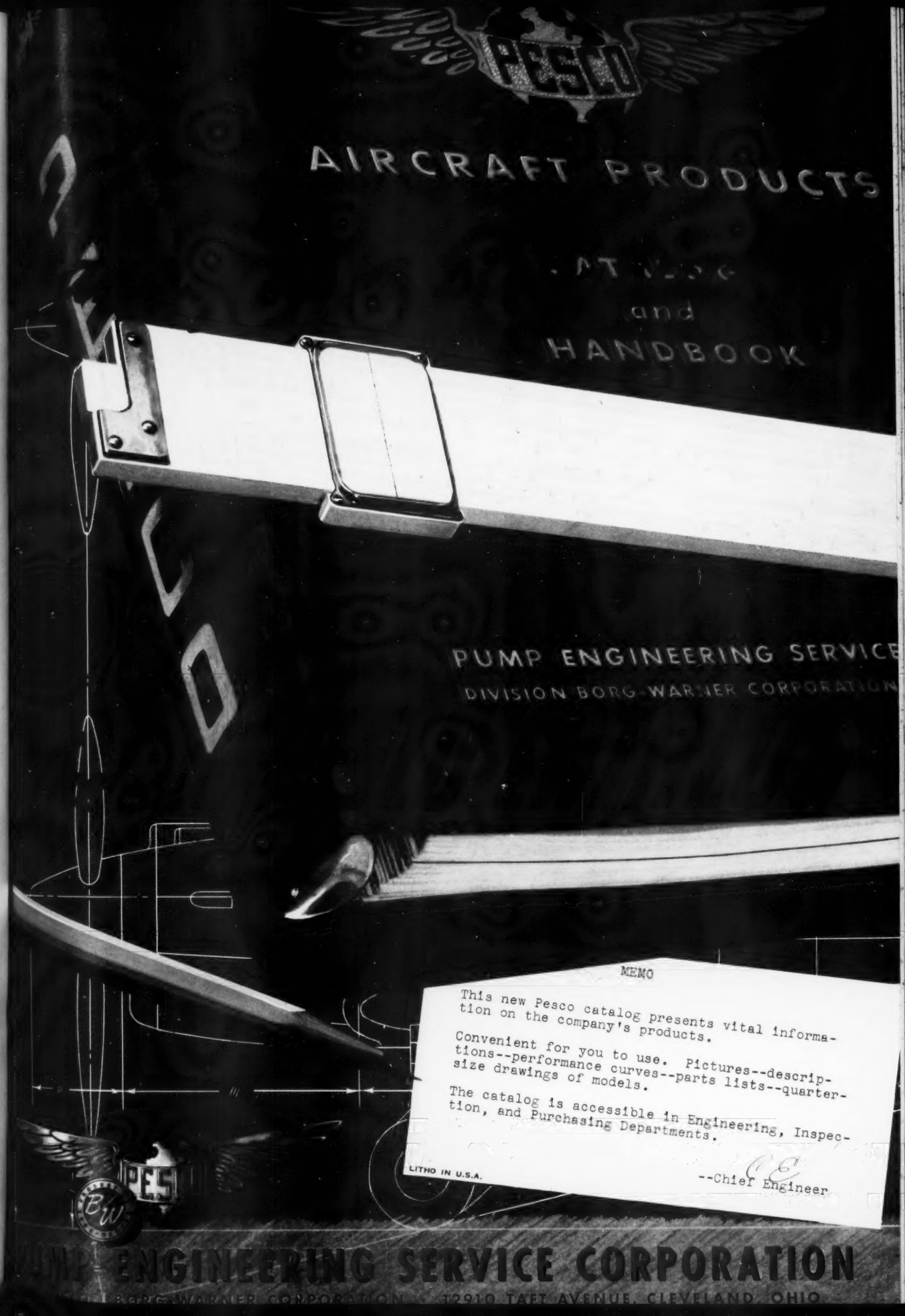
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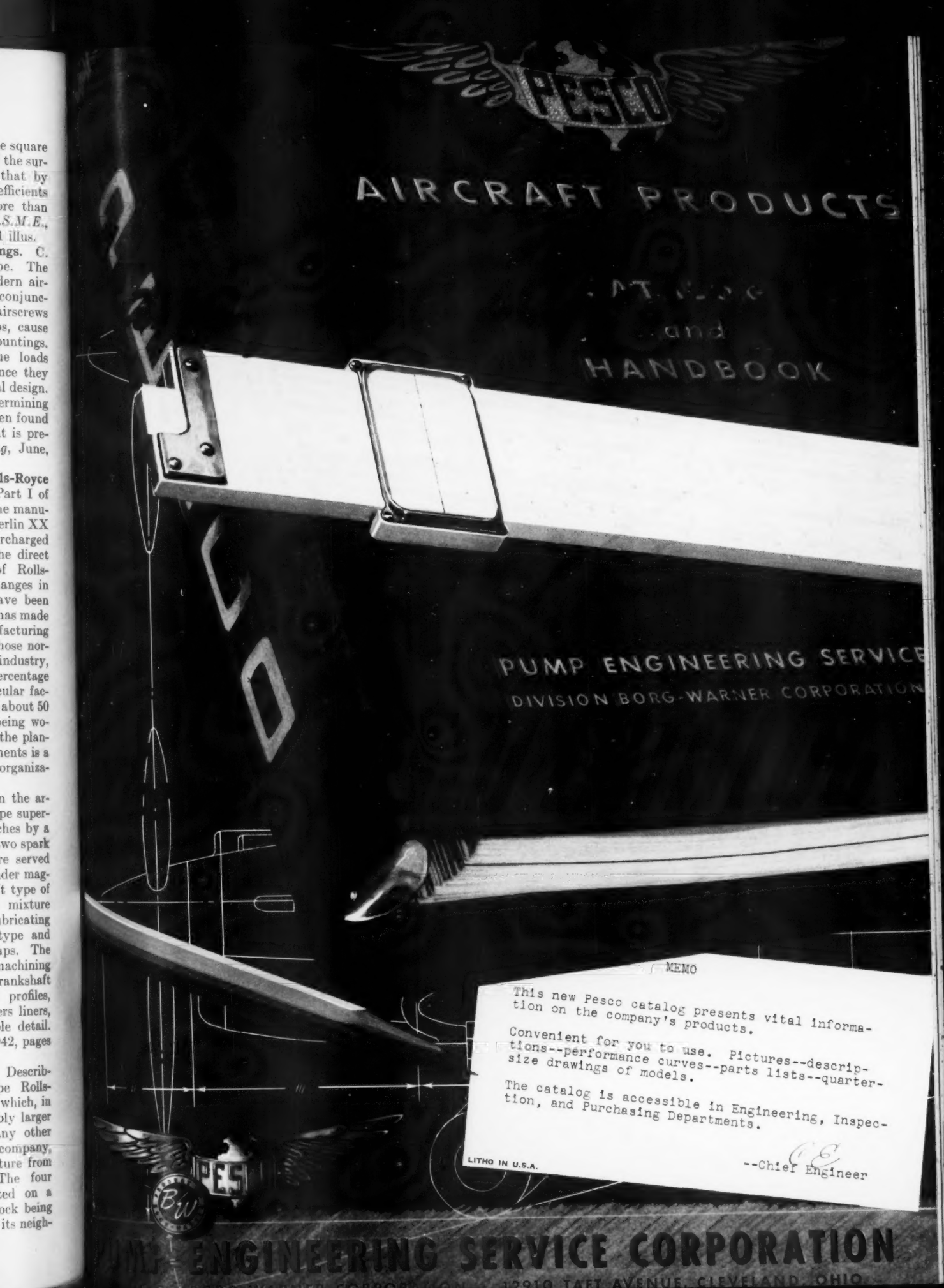
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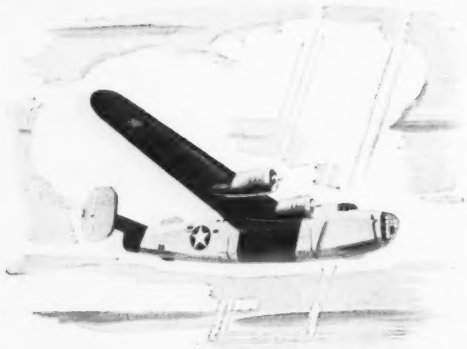

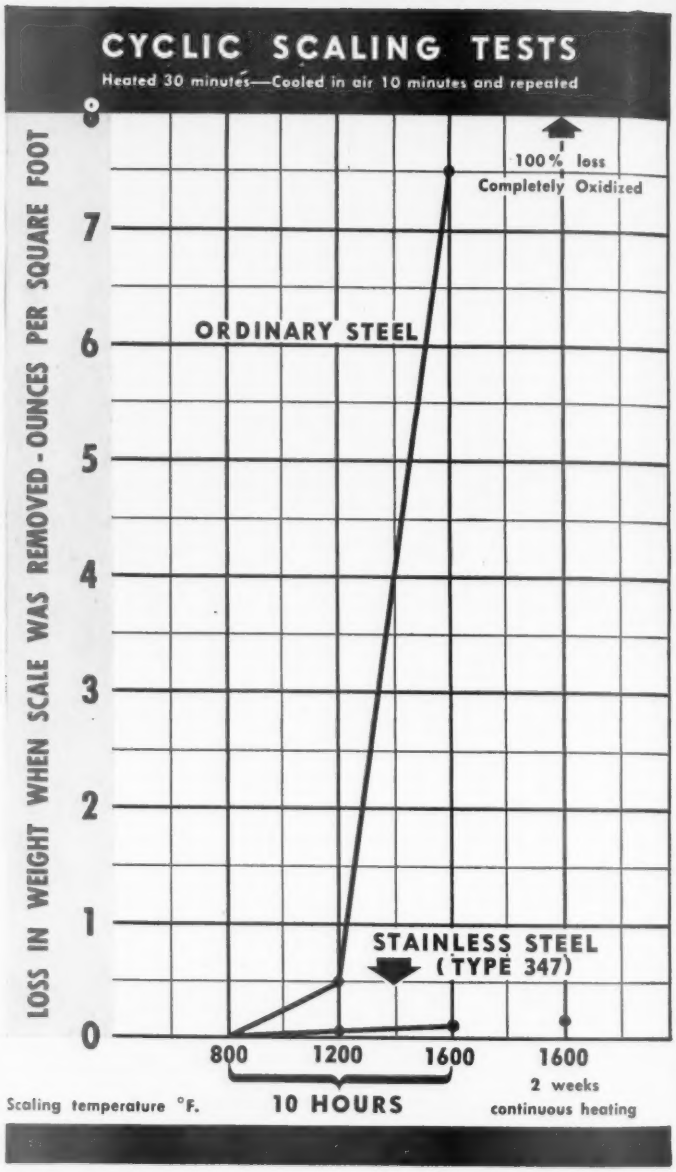

When "souped-up" high-horsepower warplanes go on distant missions only the most scale-resistant metals can endure the cherry-red temperatures inside the exhaust system. This is why heat-resisting ARMCO Stainless Steels are used in building many of these planes.

The chart tells *how well* stainless steel performs. After a test of 10 hours at 1600° F., ordinary steel showed a weight loss of 7.6 ounces a square foot compared to a loss of .035 ounces for ARMCO Stainless (Type 347). In a *continuous heating* test for two weeks at 1600° F., ordinary steel became completely oxidized before the end of the test. Type 347 ARMCO Stainless of the same gage showed a weight loss of *only .065 ounces!*

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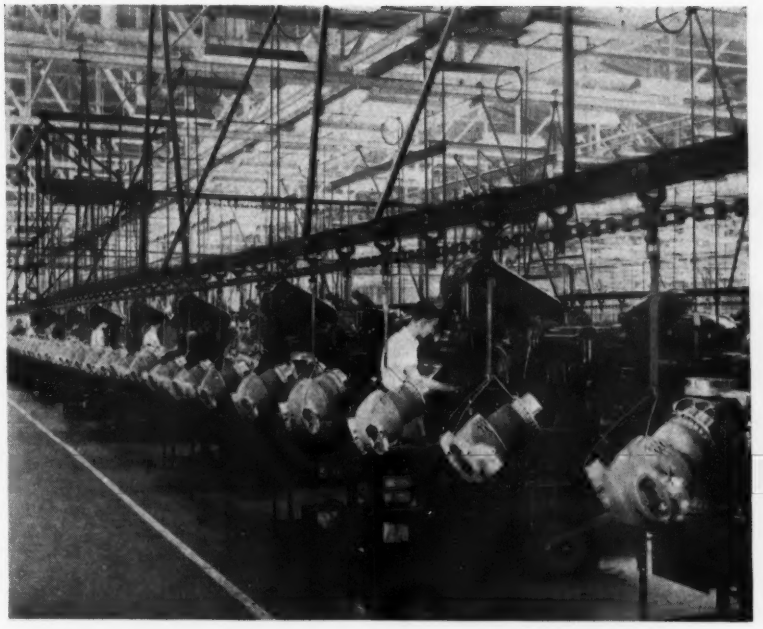
bor. Cylinders of 5 in. bore by 5½ in. stroke provide a total displacement of 2,592 cu.in. At an altitude of 5,000 ft., when using the low supercharger gear, the output is 1,845 b.hp. Many details of design are similar to the Merlin. While this engine showed considerable promise, production has been discontinued in favor of concentration on earlier types. This engine, details of which have recently been made available, was fitted to the Avro-Manchester bomber. *Aircraft Production*, July, 1942, page 451, 1 illus.; *Automotive and Aviation Industries*, July 15, 1942, page 23, 1 illus.

The BMW 801A Aero-motor. Data are presented on the German BMW 801A, an engine giving 1,580 hp. for take-off and 1,460 hp. at 16,300 ft. The BMW 801 series is conceded to be the most advanced power unit in operation at present, with its special qualities lying in the design of its cooling and cowling. The points of the system noted by this description are fan-assisted cooling, low-drag oil cooler, absence of gills, and single lever control.

Said to be a development of the Pratt & Whitney Twin Wasp engine, the BMW 801A is credited with more success in the reduction of drag than any other engine now in operation. Thus far it is known to have been installed in the Focke-Wulf FW 190, the Focke-Wulf Kurier, the Dornier Do 217E1 and the Blohm and Voss BV 141. *The Aeroplane*, July 3, 1942, page 20, 4 illus.

La Fabrica Nacional de Motores del Brasil (The National Engine Factory of Brazil). An agreement is reported between the government of the United States of Brazil and the Wright Aeronautical Corporation under which 235-hp. seven-cylinder and 450-hp. nine-cylinder, Wright Whirlwind engines are to be manufactured in Brazil by an aeronautical company organized by the government of that country. For this purpose a factory is being built at Boixada Fluminense about 30 km. from Rio de Janeiro, which was expected to be ready for operation in August, 1942. It covers an area of about 180,000 sq.ft., and about 500 workmen are being employed in the construction work. Near the factory a model town is to be erected, including a fully equipped hospital, the services of which will be free to employees and their families.

The Wright Aeronautical Corporation will furnish some of its specialists and technicians to supervise the manufacture of the engines. During the past eight months Brazilian engineers and technicians have been visiting the Wright factories in the United States to acquaint themselves with the various manufacturing processes. *Aeronautica*, April, 1942, page 21, 1 illus.; *Mundo Aeronautico*, April, 1942, pages 4, 5, 3 illus.



Cyclone engine cylinders on the production line.

The Merlin. James L. H. Peck. This article tells of the achievements of the Rolls-Royce Merlin and its predecessors. Mention is made of the British combat airplanes in which it is installed. Comparison is made with the Americanized version of this engine and the American aircraft with which it is used. *Air Trails*, August, 1942, pages 6, 42, 44, 3 illus.

Flight Technique

Technique in Aerobatic Maneuvers. Casey Carl Ferrante. An explanation of the technique of several specific aerobatic maneuvers. Consideration is given to the correct handling of the airplane in loops, rolls, and Immelmans. Suggestions are made on how the Immelman turn, the Chandelle, the snap roll, the slow roll, the loop, the Split "S," and their variations should be executed. *Aero Digest*, August, 1942, pages 124, 127, 128, 247, 4 illus.

Handling Tricycle Landing Gears. Major James A. Johnson. The development of landing gears is traced, and it is related how the tricycle landing gear was adopted. The operation of this type of landing gear is explained in nontechnical language and its advantages are shown. Some of the difficulties are also outlined, particularly the effects of blown tires, wet pavements and icy runways. Instructions are presented for meeting unfavorable conditions and for handling airplanes equipped with this type of undercarriage. *Aero Digest*, August, 1942, pages 174, 177, 178, 181, 191, 12 illus.

Some Aspects of Safety in Military Flying. This article analyzes the major causes of accidents in an effort to point the way toward decreasing military flying losses from mishaps that are preventable. The writer contends that few accidents can be laid to structure, engine or weather. He also emphasizes the urgent need at this time to cut down military losses from flying accidents. *Air Facts*, August, 1942, pages 5–15.

The Hazy Eight. Wolfgang Langewiesche. A detailed analysis of the Lazy Eight maneuver and the Horizon Eight by Stabilizer, together with pointers on how to perform them. The writer terms the Lazy Eight a useful and practical maneuver because it forces the pilot to become familiar with the airplane's response to various controls. He explains that in flying a Lazy Eight the elevator is held in constant position. But, although stick pressures vary throughout this maneuver, rather than being applied by the pilot's hand to the stick, these pressures build up in the stick against the pilot's hand and fade again. The pilot's work merely consists in holding the elevator steady and resisting what pressure changes he may feel. Use of the rudder, stabilizer, aileron and elevator is discussed. *Air Facts*, August, 1942, pages 17–23, 3 illus.

Aloft for Aerobatics. A study of simple aerobatics with directions on how to perform several maneuvers.

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The "sideslip," stall, stalled turn, spin, loop, slow roll, and flick roll are explained briefly. *Canadian Air Cadet*, June-July, 1942, pages 13, 20, 8 illus.

Gliding and Soaring

School for Glider Pilots. The course of training given to glider-pilot candidates at the British Army Glider Schools is described. Information is presented about the equipment used, the selection of men for the Airborne Divisions, and the instructors who have received their experience with either the Royal Air Force or the Fleet Air Arm. Glider technique as it is followed in these schools is explained. Comment is also made about the Hotspur, the glider employed for training. *The Aeroplane*, July 3, 1942, pages 22, 23, 4 illus.; *Flight*, July 2, 1942, pages 7–9, 6 illus.

Leatherneck Gliders Ready for Action. Lt. Gordon Hagberg. Glider developments by and for the Marine Corps are detailed. Accent is placed on the versatility of the glider in military service. Information is furnished on the instruction given and the proficiency required in the extensive glider-training course set up by the Marine Corps. Steps to be taken in the practical application of gliders to present-day warfare are outlined. *Southern Flight*, July, 1942, pages 20, 21, 3 illus.

The Birth of a Glider. Steps in the development of gliders and glider trains are traced in the form of a diary. It shows the day-to-day progress made at the Aeronca plant in the design, construction and testing of gliders. The summary indicates that the total time in the air for glider tests was 41 hours and that 61 tows were made. *Western Flying*, July, 1942, pages 48, 54, 4 illus.

Icing

The De-Icing Equipment of a Dornier Bomber. From notes supplied by the British Ministry of Aircraft Production considerable information is given on the deicing equipment of the Dornier Do 217E heavy bomber. The deicing equipment fitted to the wings is a hot air system, while that for the airscrews is a fluid and slinger-ring system. For the pilot's windshield and for each of the windows hot air sprays are fitted. No provision is made for deicing the tail plane, fins or aerial mast. The wing deicing system is described in considerable detail including the method of conducting heated air from the exhaust pipes. Two wing-heater muffs for the cabin-heating system are situated on separate exhaust pipes behind each engine and consist of cylinders concentric with the exhaust pipes, being closed at both ends with pipes leading in and out. For deicing the propellers the fluid is carried from a flexible self-sealing tank and is pumped by an electrically driven pump through a filter to the slinger rings. Details are given on the piping and the method of carrying the fluid through the engine-cooling fan. Flow figures for the fluid are tabulated. *The Engineer*, July 3, 1942, pages 6–8, 7 illus.

Influencias de las Temperaturas Bajas en la Navegacion Aerea (Effects of Low Temperatures in Air Navigation). Horacio A. Sirito. In reply to inquiries from readers on the effects of low temperatures upon airplanes in flight, the writer explains in nontechnical language the formation of fog, clouds and ice. Because ice accumulations on various parts of an airplane may lead to serious consequences, the causes of the formation of ice and its prevention constitute the largest part of this study. *Avia*, April, 1942, pages 103–105, 4 illus.

Inspection

Inspecting Martin Bombers. Photographs of inspection operations at the plant of The Glenn L. Martin Company. These include illustrations of the inspection of controls, engine mounts, landing gear struts and bulkheads. *Automotive and Aviation Industries*, July 15, 1942, pages 34, 35, 6 illus.

Inspection of Bearing Surfaces. W. N. Twelvetrees. Developments in bearing design and bearing metals, especially in the aircraft field, have necessitated a new inspection technique. With the new bearing materials, the desirable clearances and surface conditions differ from those for earlier alloys. The paper reviews inspection as applicable to finished bearings, but, in order adequately to cover the subject, it also discusses the fundamental properties of bearings and how they have been developed. Photographs show bearing wear due to the effect of oil corrosion and other conditions. *Aircraft Engineering*, June, 1942, pages 173–177, 7 illus.

Instruments

Examination of German Aircraft Navigation Instruments. F. Postlethwaite. This article reveals details of aircraft navigation instruments captured from the Germans. Since such instruments usually have been recovered from aircraft which have been shot down, force landed, or crashed, only a few are in good working condition. When an instrument is sufficiently interesting, reconstruction

often is carried out, parts from other instruments recovered being used when possible. In instruments examined so far, few features worth copying have been found, it is stated, but the information gained is useful in showing the working standards and materials used and in keeping a check on enemy instrument developments.

One instrument described is a spirit level sextant, the unusual feature of which is an integrating device in many respects similar to a planimeter, to give the true mean observation over a period of time. Another instrument is a periscope drift sight designed to project through the side of the fuselage, thus being in a convenient position to be used by the navigator. Details also are furnished on a height proximeter, believed to be used as a height indicator during mine-laying operations. *Journal of Scientific Instruments*, July, 1942, pages 97–101, 6 illus.

Lighter-Than-Air

Watchdogs of the Sky. Lt. William P. McCahill. The purpose of barrage balloons and the strategy involved in their operation are related in connection with a description of the barrage balloon base in the Marine Corps barracks at Parris Island, S. C. A brief biography of Lt. Col. Bernard Lewis Smith, the commanding officer, is followed by an outline of the organization of the Barrage Balloon Base I. The construction of the balloon is detailed, as well as the methods of anchoring it to the ground and the mechanism used for inflating it, sending it aloft, and bringing it back to earth. *National Aeronautics*, July, 1942, pages 14, 15, 2 illus.

Airship Carriers. Tom Ashley. Predictions are made that the Government may experiment with lighter-than-air carriers for airplanes. In the recent authorization by Congress for the construction of 200 lighter-than-air craft without limiting them to the nonrigid dirigible type, the writer sees possibilities of large, fast, super airships to carry airplanes. Capt. C. E. Rosendahl is quoted to the effect that airship carriers have been proved successful in many tests and have numerous advantages. Specifications are set forth for aircraft of this type and comments are made on their operation. Their so-called vulnerability is defended, their superiorities are stressed and their record is cited. Services performed by blimps in combating submarines are noted. *Southern Flight*, July, 1942, pages 16–18, 30, 5 illus.

En Barquilla Abierta a la Estrastosfera (In an Open Balloon Basket Into the Stratosphere). Alexandre Fomine. From the Russian magazine *Revue de Moscou*, there is reprinted a description of a record-breaking altitude flight by the Russian balloon SSSR-VR-79. This ascension was made with open baskets on February 13, 1941, an altitude of 11,000 m. being reached. *Aeronautica Argentina*, May, 1942, page 2173.

Maintenance

Work Service Flight at Work. Exemplifying the purpose of the Royal Air Force Work Services Squadrons, a description is given of one of the units laying a perimeter track, constructing a metal transportable runway of a wire mesh type, and performing what is known as a "Blitz Drill."

The organization of the Work Services Squadrons and the function of each of its subunits are also explained. Royal Air Force equivalent of the Royal Engineers of the Army, and responsible for the construction and maintenance of airdromes in the field, this corps is divided into the following parts: Works Squadrons, Plant Squadrons, Construction Flights, Mechanical and Electrical Flights. *Flight*, July 9, 1942, pages 41–43, 11 illus.; "Self Help at R.A.F. Airdromes," *The Aeroplane*, July 10, 1942, pages 40, 41, 8 illus.

Keeping Them Flying. Several test rigs evolved by the Service Equipment Section of the British Overseas Airways are described. This section is entirely devoted to the design and development of special equipment for the maintenance and overhaul of aircraft. Details are given on the following: the Universal Instrument Stand, produced to test instruments and units not included with the engines, such as Sperry Autopilot instruments, oil pumps, vacuum pumps, oil gauges, temperature gauges, flow meters, etc.; the Universal Airscrew Stand, designed to receive the airscrew straight from the engine and to transport it in a vertical position direct to the airscrew repair shop on its own wheels; an Airscrew Blade Twisting Machine for Preformed Shapes, constructed to reset the helix angle in airscrews which have become damaged; the Autopilot, Horizon and Gyro Rudder Test Rig insures the testing of instruments under conditions identical to those when the airplane is banking, climbing, diving, or yawing. With their Plug Testing Machine and Servicing Equipment aircraft engine spark plugs can be rapidly tested for efficient performance. *Flight*, July 2, 1942, pages 16, 17.

Airliner Maintenance. Harry Wilkin Perry. An account of how the lives of United States airliners are prolonged and their equipment kept up to date by constant care and inspection. Details are given on inspections and replacements made after 50, 100 and 700 hours and the complete overhauls made on the airline transports after 3,500 hours. For an idea of how thorough this maintenance is, figures are given to show that the number of ground crew members per aircraft has increased in the last ten years from 14 to 60. *Flight*, July 9, 1942, pages 47–49, 4 illus.

Maintenance Training with Movies. David G. Forman. An account of how Bell Aircraft instructs military and civilian personnel in the maintenance of aircraft through the medium of sound films distributed to operational centers all over the world. This program of training through the use of motion pictures consists of two phases: films for use by the service department, in the field and at its schools; and films for use by the company in training production workers. Details are given on the making and distribution of the motion pictures. *Aviation*, August, 1942, pages 207–209, 8 illus.

Eliminating Dust and Dirt from the Air Intake. Difficulties caused by dust and dirt are emphasized by operations from airports where dustless surfaces are not available. Various types of carburetor air cleaners are discussed and information is presented on the location and use of such devices. Suggestions are made for relocation of the air intake where possible, but it is pointed out that the adoption of either one or both of these remedial measures will not be a cure-all for engine wear caused by sand and dirt. Measures are suggested for minimizing these conditions. *Aero Digest*, August, 1942, pages 160, 237, 240, 241, 4 illus.

Repacking Bearings. Paul Montgomery. A service that has been developed to relieve aircraft companies of some of the details of their work is a system for cleaning and repacking bearings. This has been inaugurated by a concern specializing in that field. The five steps involved in cleaning and relubricating bearings are outlined. *Aero Digest*, August, 1942, pages 186, 191, 5 illus.

Management

Air-Line Engineering Management. Ivor Lusty. Various aspects of the engineering management of airlines are discussed, it being pointed out that the production and marketing of aerial communications and transportation is a young industry.

As an enterprise grows in size, reapplication of talents takes place, and the owners or their mandated

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representatives employ themselves directing, managing or administering the work of others. Methods of administrators are themselves subject to development. While great respect is due to those whose native ability makes them good administrators, more consistent results can be expected when the information and data available for these administrators are improved in character and range and in the modes of presentation. This article represents the first of a series intended to show how such information is collected and applied in the solving of industrial problems. *Aircraft Engineering*, July, 1942, pages 201, 202.

Production Aided by Interchange of Plant Personnel and Facilities. Richard W. Millar. Details of the purpose and functions of the Aircraft War Production Council whose members—eight major western aircraft manufacturers—interchange information and facilities for greater war production. Helping to eliminate bottlenecks, this correlation and pooling plan is conducted without profit to any member, supplying needed facilities, information, or personnel to each other. The policy of the Council is to have all its members working together to obtain maximum return from machine and man-hours.

Seven functional groups divide the responsibility of the council into production, material, transportation and housing, accounting, industrial and public relations, engineering and standards, and plant defense. Some of the results achieved by these committees are: a procedure for standardized listings of machine capacity and load established by the Production Committee; and a unified method of accrediting aircraft workers in need of tires, worked out by the Committee on Transportation and Housing. The Engineering and Standards Committee has exchanged and made available to other war industries a number of engineering reports on such topics as Test Results on Torpedo Rack Cable, Static Tests on Nickel-Moly, Flame Dampening Engine Exhausts, etc. The Accounting Committee has established means of obtaining tabulating equipment for emergency work. The Plant Defense Committee is making studies of plant defense installations by personal visits of company specialists. *Aero Digest*, August, 1942, pages 78, 247–249, 1 illus.

Materials

Cold-Rolled Stainless Steels in Aircraft. Russell Franks and W. O. Binder. This study of the cold-rolled austenitic stainless steels shows

the necessity for controlling the composition of the steels and the amount of cold work applied for the purpose of maintaining ductility and high strength. Ductility is emphasized, since this property is held to be of major importance as a factor in fabrication. With proper control of the composition and the percentage of cold reduction, it is stated that the steels have predictable stress-strain characteristics and may be satisfactorily used in light-weight, high-strength structures. Within a limit of tensile strength of not much more than 150,000 lbs. per sq.in. a composition of 18 per cent chromium and 8 per cent nickel is regarded as satisfactory, but for higher tensile strength, up to 175,000 lbs. to 200,000 lbs. per sq.in., the cold-rolled 17 per cent chromium and 7 per cent nickel steel is recommended because of its higher ductility.

It was further found that the compressive yield strength of 18–8 steel in the direction longitudinal to rolling is less than the tensile yield strength, a fact that should be considered in using this material. Higher compressive yield strengths are found in the 17–7 steel and in the 17–5–4 steel, which more nearly approach their tensile yield strength in the direction longitudinal to rolling. However, in the direction transverse to rolling, the compressive yield strength of each steel is higher than the tensile yield.

Improvement in the compressive yield strength of all of these steels, in both directions to rolling, is secured by application of low-temperature heating treatment between 200° and 300°C. Ordinarily, heating for 24 hours within this temperature range is sufficient, although it may consume a period up to 72 hours. It is found that after this treatment the compressive and tensile yield strengths of the 17–5–4 steel are approximately the same.

Numerous photographs are presented showing applications of 18–8 and 17–7 steels in aircraft construction. They show the forming characteristics after cold-rolling and show the use of spot welding in joining the stainless steel sections. These steels, combined with spot welding, give the characteristics of strength, ductility and corrosion resistance, making them suitable for structures light in weight and high in strength. *Mechanical Engineering*, August, 1942, pages 589–598, 10 illus.

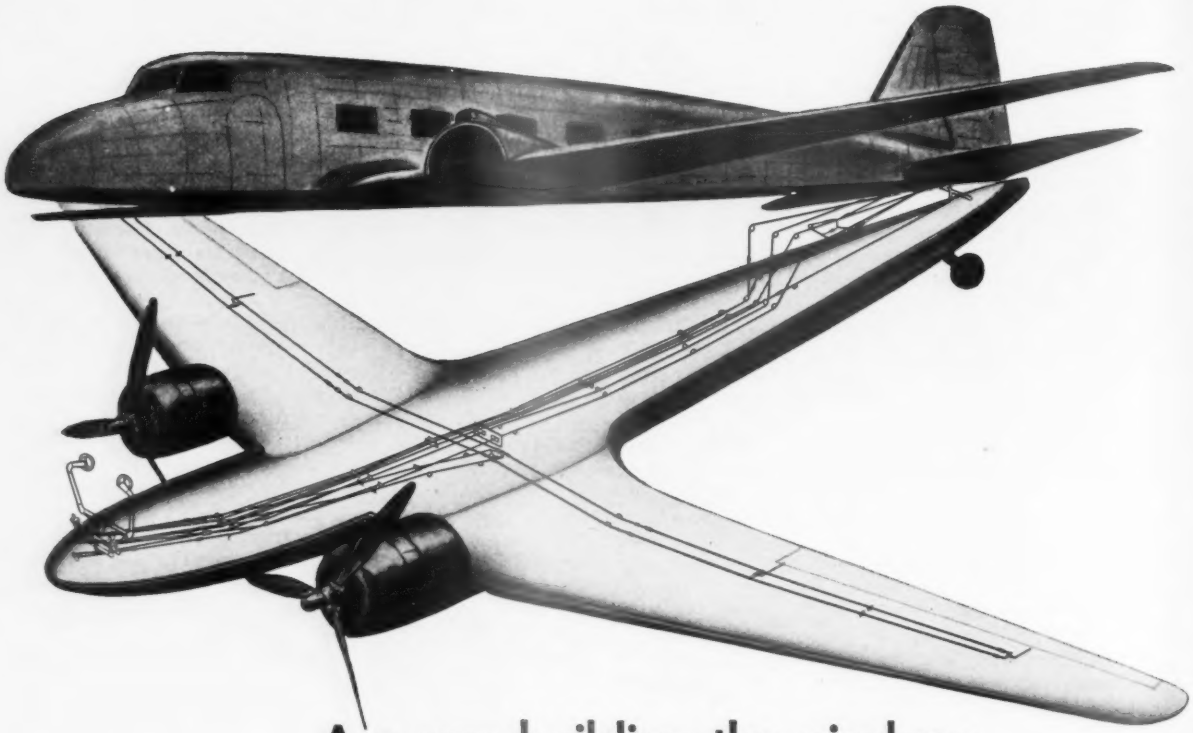
Northern Tropical America as a Source of Rubber. Stanley S. Kogut. Sources are explored for the crude rubber or substitutes necessary for the construction and operation of aircraft. The many functions of rubber in this work are briefly outlined and mention is made of several hundred trees and bushes found in northern tropical America which have latex from which rubber articles can be made. Native rubber only is considered—that is, products of latex tapped from a tree. A bush developed in Russia is mentioned which is said to have possibilities as a yielder of rubber and has the advantage of being native to temperate zones. The history and early uses of rubber are reviewed. It is stated that rubber supplies exist in Haiti and Mexico, the latter country being a source of the guayule rubber.

The conclusion is drawn from reports of the Department of Agriculture that there are at least 6,000,000 acres suitable for growing of rubber trees in Central American countries and the West Indies. The cost of developing rubber there has been the drawback in the past, but it is stated that cost is no longer a factor. However, it is said to be probable that the synthetic rubber program can be developed before large production could be thus grown. *Aero Digest*, August, 1942, pages 147, 148, 150, 340–343, 5 illus.

Engineering in Wood. James E. Thompson. Desirable properties of wood as a material for the construction of airplanes are set forth in a study of the problems of substituting wood for critical metals. The characteristics of various woods are considered and instructions are given for the selection of the proper wood for individual parts of an airplane. Moisture content, nature of grain and other factors are explained with reference to the kind of service they are to perform. Instructions are given covering methods of construction and fastening. A second part of the article, to appear in a subsequent issue, will discuss manufacturing methods for wood airplanes. *Western Flying*, July, 1942, pages 50, 52, 54, 4 illus.

Medicine

The Physical Maintenance of Transport Pilots. Jan H. Tillisch and W. Randolph Lovelace, II. Results are published of a study of the physical condition of 103 air-line



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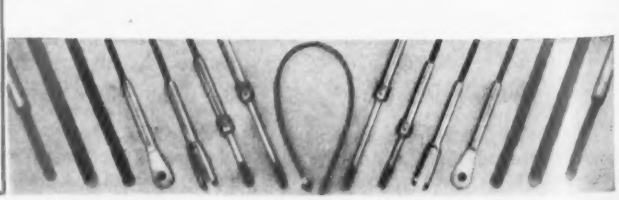

pilots carried out in cooperation with an air transport company. All of these men were flying regularly and had not complained of ills. The results of these examinations are given in detail. It was found that 52 of the pilots had evidence of foci of infections which might lead to serious illness. Forty-one had some slight impairment of hearing, one had active pansinusitis and five had duodenal ulcers, only one of which had been previously diagnosed. There was a high incidence of genitourinary disease, nine pilots having some type of this condition. One pilot had a hernia. Out of the entire group, 71 were found to have physical defects which could affect or were affecting their health. *The Journal of Aviation Medicine*, June, 1942, pages 121–129, 2 illus.

Problems in the Selection of Aviators. Eric Liljencrantz. Problems and procedure in connection with the selection and maintenance of aviators for the exacting demands of naval aviation are discussed in detail. Because selection precedes maintenance from a time standpoint, its importance is apt to be overestimated, though it does do much to determine the range of performance on which maintenance is to be effected. In dealing with this complex problem the effort should be to select individuals with a balanced broad ability, rather than those with single extraordinary traits. Physical standards for aviators, which presuppose sound health, are outlined. High tolerance for the conditions accompanying high-altitude flight, ability to withstand sharp acceleration and fatigue, and strong emotional stability are important requisites. The sequence of selection procedures as now applied in naval training is given, and the need for further investigation is cited. *The Journal of Aviation Medicine*, June, 1942, pages 107–120.

Studies on the Effects of Adding Carbon Dioxide to Oxygen-Enriched Atmospheres in Low Pressure Chambers. A. E. Johnson, M. Eckman, C. Rumsey, Jr., and A. L. Barach. It is well known that even when inspiring pure oxygen there is a rapid fall in arterial oxygen saturation with accompanying symptoms of anoxemia at altitudes over 35,000 ft. At altitudes above 41,000 ft. pilots may be exposed to extreme danger even when breathing pure oxygen. This study represents a further investigation to determine whether or not the addition of carbon dioxide might physiologically alter the individual sufficiently to increase altitude tolerance. Low-pressure chambers were used in the investigation with dogs as subjects. Tables, charts and other data giving the results of the study are furnished. *The Journal of Aviation Medicine*, June, 1942, pages 131–142, 3 illus.

The new Curtiss C-46 Commando military transport. Said to be the world's largest twin-engine airliner, the Curtis weighs 50,000 lbs. fully loaded. U.S. troops are shown standing at attention after disembarking.

The Value of Limitations of the Electrocardiogram. Capt. Sidney Schnur. This article opens with a brief summary of electrocardiology and continues with an explanation of what information can be obtained from an electrocardiogram. According to the laws of electrodynamics, any change in the electromotive force passing through a sensitive quartz string suspended in a constant-strength magnetic field will cause the string to shift its position in the field. This is the principle on which the instrument operates. The constantly changing electrical force transmitted through the body during the heart cycle is conducted to the instrument and the variations are recorded on a sensitized film by suitable means. The writer proceeds to review the sequence of cardiac cycle events in order. Those conditions in which the electrocardiogram is of no value are described and its worth in clinical diagnosis is discussed. *The Journal of Aviation Medicine*, June, 1942, pages 143–147.

Tales Told by Ears. Alexander Klemin. This brief article tells how a new device called the "Oximeter" measures the efficiency of a pilot in the thin air at high altitudes by recording the oxygen saturation in his blood. The symptoms and results of insufficient oxygen are set forth and an explanation is given of the superior results obtained by the use of the new instrument, compared with previously existing methods.

The instrument functions through the change of color of blood as the oxygen content changes, thus permitting accurate measurement by means of a photocell and a galvanometer. Connected to the pilot's ear, the instrument reveals the condition of the blood stream. *Scientific American*, August, 1942, page 86, 2 illus.

Aerial Transportation of Patients. W. Randolph Lovelace, II, and H. Corwin Hinshaw. With special reference to traumatic pneumothorax, diagrammatic hernia, and mediastinal emphysema, this is a study of the effect of transportation by aerial ambulances on patients who have sustained traumatic injuries to the thorax. As a guide for the selection of modes of transportation for such patients, findings are set forth that reduced barometric pressure results in a marked tendency to expansion of air within a pneumothorax cavity, even at the moderate altitudes commonly attained by commercial passenger-carrying aircraft.

It is cautioned that if examination reveals reduction or absence of breath sounds on either side, or should subcutaneous emphysema be noted, in the case of patients who apparently have thoracic injuries there is increased hazard in transporting them at altitudes over 3,000 ft. At assured low altitudes, there are no definite contraindications to ambulance airplanes. However, it is recommended that they be supplied with proper equipment to permit aspiration of air from the pleural cavity should the necessity arise. *War Medicine*, July, 1942, pages 580–585, 3 illus.

Military Aviation

U.S. Winged Army, Once a Dream, Now a Reality. Major Frank L. Nelson. With the recent announcement by Lt. Gen. H. H. Arnold, Commanding General of the Army Air Forces, of the Formation of a Troop Carrier Command, early dreams of air-minded officers of the United States Army have become a reality, it is stated. The transportation by air of fighting men, their weapons and supplies, to theaters of operations will be the function of the command. It is predicted that the size of this force eventually will exceed anything of its kind the

world has seen. A photograph of the new Curtiss-Commando military transport, now being delivered to the Army Air Forces by the Curtiss-Wright Corporation, is shown. *U.S. Air Services*, August, 1942, pages 11, 12, 1 illus.

Getting 'Em Flying. Esther H. Forbes. An account of an exhibition flight of a Navy Vought Corsair made at a rally held by the Vought-Sikorsky War Production Drive Committee at Stamford, Conn. The F4U is powered by a 2,000-hp. Pratt & Whitney double Wasp engine and is said to fly faster and further than any other Navy fighter. *U.S. Air Services*, August, 1942, pages 32, 42, 1 illus.

Putting Things Together Again. The function of the Royal Air Force Salvage Units is explained. Data are given on how this branch of the Royal Air Force picks up pieces of crashed airplanes, repairs them, and utilizes them for replacements. Those portions of wreckage that cannot be used for parts in other airplanes or broken into components are reduced to scrap and utilized in that manner. *The Aeroplane*, July 10, 1942, page 51, 3 illus.

La Infanteria Del Aire (Infantry of the Air). Nilo Guerreiro. A review is presented of the history and tactical use of parachutists and air-borne troops. It is stated that although the Russian army engaged in large-scale experiments in the training of parachutists the first actual parachute troops came into being in 1938 when the German Luftwaffe incorporated them into its 7th Aerial Division. Many members of this division gained practical experience as "volunteers" in the Spanish civil war. Since then the Germans have extended this service to such a degree that it was instrumental in bringing about the conquest of Norway, Holland, Belgium, France, Greece and Crete. No information is available on the use of parachutists by either of the belligerents in the present hostilities between Russian and Germany.

It is indicated that parachutists were intended at first to create disturbances in the rear of the enemy army, by committing sabotage, destroying vital structures such as bridges, railroads, factories producing war materials, tunnels, etc., or occupying certain positions on the ground ahead of the enemy. Such positions are selected in advance of the action as being of great importance in the struggle to follow. It is said that in modern warfare parachutists are employed primarily to occupy enemy flying fields and thus facilitate an undisturbed landing of air-borne troops. *Avia*, April, 1942, pages 117–120; *Aeronautica Argentina*, May, 1942, page 2199.

Sub Hunters. Photographs are reproduced to show the activities of the Army Air Forces in flying the offshore Atlantic patrol on the watch for lurking submarines. *Air Trails*, August, 1942, pages 18, 19, 13 illus.

Flying, as It Was—. Some of the early military flying operations in Mexico are reported. Since these operations were mainly in connection with Mexico's internal disturbances, air duels and the dropping of bombs were their main purposes. *The Sportsman Pilot*, July 15, 1942, pages 13, 34, 36, 1 illus.

Model Airplanes

Model Makers Go to War. Albert Lewis. Contributions made by students and other young men to the training of airmen in aircraft identification through the construction of exact-scale model airplanes are credited with considerable importance in this description of the work undertaken under a naval training program.

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Several thousand school systems throughout the nation are cooperating in this work, which is also beneficial through developing skill in precision work on the part of the students. It is stated that up to the present 40 states have taken part in the program and more than 300,000 of the requested 500,000 model airplanes have been delivered to the Navy. *National Aeronautics*, July 1942, pages 18, 19, 3 illus.

Naval Aviation

Torpedo Aircraft. Squadron Leader J. C. Brooke. A brief history is given of the development of torpedo-carrying aircraft by the British Navy, it being stated that the first attempts to lift torpedoes were made in 1913 and 1914 with a Short and a Sopwith floatplane. The evolution of this type of aircraft through the torpedo bomber to the torpedo-spotter-reconnaissance airplane is traced. Reasons for the inefficiency of the latter type are that it must carry a crew of at least three, that it has a considerable weight of fixed equipment and that changes in the distribution of loads introduce structural and aerodynamic problems. Other factors bearing upon this type of aircraft are discussed and existing classes of torpedo bombers used by the British, Japanese, Italians, Germans and Americans are tabulated. *Aeronautics*, July, 1942, page 45; "Our New Torpedo Bombers to Batter the Axis," *Popular Science*, September, 1942, pages 91–95, 12 illus.

An Analysis of Aircraft Carrier Design. Francis E. McMurtrie. Development of the aircraft carrier in the British Navy is traced. The writer draws a distinction between ships adapted for carrying aircraft and those especially designed for the purpose, crediting the "Campania" as the first ship of the Royal Navy to be equipped as a seaplane carrier, while H.M.S. "Furious" is said to have been the first actual aircraft carrier. How the flying decks were evolved for the "Furious" and for later ships is recounted. The achievements of such other famous aircraft carriers as the "Argus," "Eagle," "Hermes" and others are narrated.

This is followed by an account of the operations of aircraft carriers attached to the United States fleet, brief descriptions being given of the U.S.S. "Lexington" and "Saratoga" and the later aircraft carriers "Enterprise," "Hornet," and "Yorktown," as well as the small aircraft carriers "Ranger" and "Wasp." The writer states that the "Ranger" was the first United States warship to be designed as an aircraft carrier. Numerous other new American carriers are mentioned, along with a number of merchant vessels that have been transformed into escort aircraft carriers.

United States and British aircraft carriers are compared. The article continues with a description of the types of aircraft with which the American carriers are equipped, the statement being made that the United States Navy has the advantage of a greater variety of aircraft than the British service. Some information is included on Japanese carriers and the airplanes they carry, although knowledge on this subject is limited. The article concludes with brief comments on Russian aircraft carriers and a tabulation gives the specifications of British carriers that were in service or building at the outbreak of the war. *Aeronautics*, July, 1942, pages 38–44, 15 illus.

The Torpedo-Bomber. This article is presented as a refutation of one which appeared in *Model Airplane News*. Claiming that the article referred to was inaccurate in several statements that credited the United States with certain pioneering developments in aircraft torpedoes, the refutation surveys the contributions of the British to air-torpedo development prior to 1923. To prove its point eight British torpedo airplanes, produced before that year in which the first United States torpedo plane was said to be manufactured, are listed. Mention is also made of the early work in this field done by Germany. *The Aeroplane*, June 26, 1942, page 721, 2 illus.

Patrol Planes at Sea. Col. Nikolai D. Ezhov. An article written in Russia and cabled to the United States covering aviation action at sea in the protection of Soviet naval bases and communication lines from surprise attacks. Patroling activities, in which pursuit planes are mainly used, are described in considerable detail. The writer tells of successful engagements with the enemy and draws comparisons between Soviet and German methods of fighting. German flyers rely in the main on numerical superiority, whereas Soviet flyers depend largely on skill. *U.S. Air Services*, August, 1942, pages 28, 46.

The Future of Water-Based Airplanes. Capt. Frank T. Courtney. Third in a series on flying boat design, this article compares the fundamental shortcomings of landplanes and waterplanes with regard to maximum operational efficiency. In the former the landing gear is called a handicap on the basis of aerodynamics but more especially because of weight considerations. Six principal handicaps of the flying boat are listed: (1) excessive width of body, due to hydroplaning beam and buoyancy requirements; (2) excessive height of body, due to propeller-water clearance requirements; (3) drag of steps, presumed to be necessary for hydroplaning requirements; (4) drag of chines, employed for spray and water-flow control and which hinder body streamlining outside of a small range of angles; (5) miscellaneous items such as body distortions for raising tail clear of water, added fin area largely for stabilizing the oversize body; (6) wing-tip floats (or sponsons) for lateral stability on water. However, the article attributes much of the waterplane's deficiency to the fact that no important change has been made in the development of its design since 1913. *Aviation*, August, 1942, pages 93, 94, 95, 252, 255, 4 illus.

Midway's Avenger. The Battle of Midway is recounted, with particular reference to the performance of the Grumman TBF-1 torpedo bomber, known as the Avenger. To a recital of the exploits of this and other airplanes in that battle, a brief and nontechnical description of the Grumman Avenger is added. *Model Airplane News*, September, 1942, pages 26, 27, 40, 42–44, 3 illus.

Is the Carrier Obsolete? Advantages and disadvantages of surface aircraft carriers are assessed in the light of recent battles in which they have participated. Under the headings of cost, dispersion, productability, maneuverability, defense and structural strength, the factors bearing upon surface-type aircraft carriers are analyzed. Mention is made of the use of large lighter-than-air craft for carrying and launching combat planes. It is concluded that the virtual monopoly held by the United States on helium gives this nation a unique position in lighter-than-air war equipment. *Air News*, August 15, 1942, pages 11–13, 39, 8 illus.

Sea Nests for War Birds. Walton L. Robinson. Achievements of aircraft carriers in the present war are discussed, including the successes registered by British units at Taranto and Cape Matapan, in the destruction of the "Bismarck." The strength of the United States in aircraft carriers is assessed by means of a description of the existing carriers and their complements of aircraft. Details are given on the dispersement,

The Glenn L. Martin Company's giant flying boat, the 70-ton Mars, takes off for her maiden flight, her size clearly shown in the contrast of a Grumman amphibian beside her.

dimensions, armament and performance of United States' ships, as well as certain Japanese carriers. Information is presented on each of the American carriers, including the number of airplanes and equipment for storing and handling them. Protective armor, propulsion machinery, cost, general appearance and other data are given. *Scientific American*, August, 1942, pages 52–54, 82, 2 illus.

"Scratch One Flat-top!" Detailed accounts of the battles of Coral Sea and Midway demonstrate the effectiveness of a concentrated air offensive against naval power. The article states that air power seems destined completely to overshadow naval and military strength and points to the sinking of the "Prince of Wales" and "Repulse" as proof that it can sink battleships; to the battle of Coral Sea to prove that it can annihilate carriers; and to Midway to show that it can rout entire fleets. In conclusion, the theory of air superiority is further supported by quotations from de Seversky's "Victory Through Air Power." Losses of both sides in the battles of Coral Sea and Midway are given. *Canadian Air Cadet*, June-July, 1942, pages 4, 5, 11, 15, 29, 4 illus.

Personalities

The Billy Mitchell Case. Melvin J. Maas. An impartial consideration of the famous Billy Mitchell Case includes a brief biography of General Mitchell, facts surrounding the controversy, and a vindication of his determined stand for recognition of air power, based on events that have transpired since. The contributing factor of Mitchell's own impetuous, impatient personality in his arguments with the Army, Navy and Congress is explained and the men who both supported and opposed him are indicated. The article does not confine itself only to those of Mitchell's beliefs which were later proved to be correct but also points out the fallacy of some of his forecasts. It does concede, however, that in his major thesis he was correct and that many of the things that he fought for so bitterly did come about. Notable among these are the separate promotion list of the Air Forces, their virtual autonomy, the size of the air arm, the inclusion of Air Forces officers in the General Staff. . . . all closely approaching General Mitchell's idea of an independent air arm equalling in importance sea and land forces. *Flying and Popular Aviation*, August, 1942, pages 18–20, 58, 60, 65, 6 illus.

Sydney Camm and the "Hurry-box." Keith Ayling. A word picture is presented of the life and work of the designer of the Hawker Hurricane. Influences that had a bearing on his career are noted, as well as the accomplishments of the aircraft he has designed. *Air Trails*, August, 1942, pages 10, 46–48, 2 illus.

Born to Fly. W. B. Courtney. Incorporating a biographic sketch of Lt. Gen. George H. Brett, this article tells of his accomplishments and responsibilities in his current assignment as commander of the Allied air forces in the Southwest Pacific. It relates his experiences in the present war, tracing his activities from the pioneering of the South Atlantic ferry run, his service in the Middle East before the United States declared war, and in India, Burma and Australia since that time. *Colliers*, August 8, 1942, pages 13, 38, 39, 1 illus.

Personnel

Democracy in Industry. Based on an address to the Toronto Advertising and Sales Club by an occupational pyschologist, this is a study of the scientific selection and placement of men for production. It also discusses the fostering of efficiency and democratic interchange of ideas. In the selection program the following procedures are deemed essential: (1) a consideration of the background and experience in a preliminary interview guided by a standardized application blank; (2) testing of intelligence by tests which have norms or standards for the job; (3) testing of skill or aptitude with standardized tests; (4) measurement of disposition or temperament; (5) physical examination by physicians; (6) for key positions and positions of trust, interest inventories and field checks of character and reputation.

After a man has been employed it is urged that he be treated according to these principles: (1) employees should be judged on the basis of evidence and not on unsupported opinion; (2) every employee should have the right of appeal from a questionable decision; (3) no employee should be promoted over his fellows except in open competition. *Canadian Aviation*, July, 1942, pages 46, 48, 54, 1 illus.

The Ladies Go to War. Kurt Rand. A report on what the Canadian Women's Auxiliary Air Force is accomplishing in their objective to take over auxiliary air force duties and relieve men for combat jobs. They are replacing men as much as possible in administrative and clerical work, cooking, transport driving; as equipment assistants, fabric workers, hospital assistants, and telephone operators. Other duties they expect to assume are those of wireless operators, dental orderlies, electricians, and balloon operators.

The recruiting, training course, qualifications, ranks, and pay of the CWAAF are also outlined. *Flying and Popular Aviation*, August, 1942, pages 47, 112, 2 illus.

Pilot Savers. E. Jay Doherty. The American Flying Services Foundation has made it possible for potential pilots with correctible physical and educational defects to overcome their handicaps and become aviation cadets. They do this by providing doctors and money for medical treatment, dental care, and schooling. This article relates how Aviators' Post 743 of the American Legion, anxious to do their share in the war, organized this service and the good that has been accomplished by it. It describes the methods whereby the Foundation raises money, its development into a nationwide organization, and the enlargement of its scope of activities. *Flying and Popular Aviation*, August, 1942, pages 48–50, 112, 5 illus.

Photography

Spies on High. William D. Bayles. An account of the photographic-reconnaissance fliers of the R.A.F. who seek out enemy locations, photograph their positions and defenses, and record the damage done by the R.A.F.

The B.F. Goodrich Airliner of the month

UNITED MAINLINER!

THE GENERAL GOT ON at San Francisco. The chap from the WPB boarded at Chicago. An Admiral was picked up at Akron. And United Air Lines sped them all to New York, rested and fit to carry on this business of winning a war. That's one of the important jobs United is doing today. Leaning back in their chairs, the travelers relax. They eat as comfortably as they could at the club. They read as though they were in the living room at home. This month B. F. Goodrich salutes United Air Lines, one of this nation's pioneers-of-the-air, and nominates its sleek, comfortable Mainliner "The Airliner of the Month"!

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Retractable landing gear brings new importance to tire tread design

BEFORE WHEELS were retracted, smooth-contour tires were often considered more suitable because they created less air-resistance. Today, retractable landing gear makes it possible for practically every plane to utilize the advantages of non-skid tires.

The brakes stop the wheels, but the tires stop the plane. Hence a tire that grips the ground can do much to prevent skidding, over-running a runway, making the split-second stops especially needed on smaller, unpaved fields used in military operations.

B. F. Goodrich has had years of experience in designing scientific non-skid designs for automobile as well as aircraft tires. Most of America's leading airlines are now running on our non-skid Silvertown Tires. Recently, we developed a new block tread-design which is now being used on our country's military aircraft, helping Uncle Sam's pilots to safer, smoother, quicker stops and providing greater ground control.

Our comprehensive aviation catalog shows some of the B. F. Goodrich Silvertown tread-designs available, and also contains De-Icer and brake information of vital interest to designers and purchasing agents. For a free copy, write to The B. F. Goodrich Co., Aeronautical Division, Akron, Ohio.

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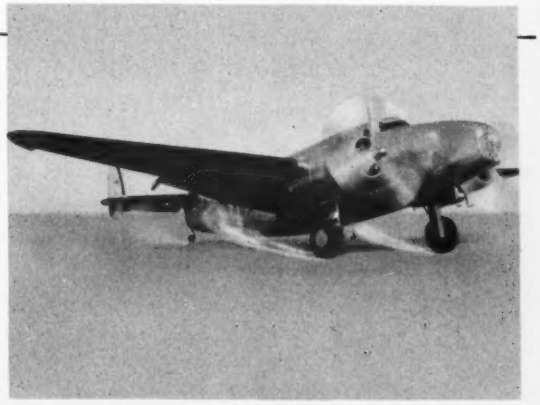
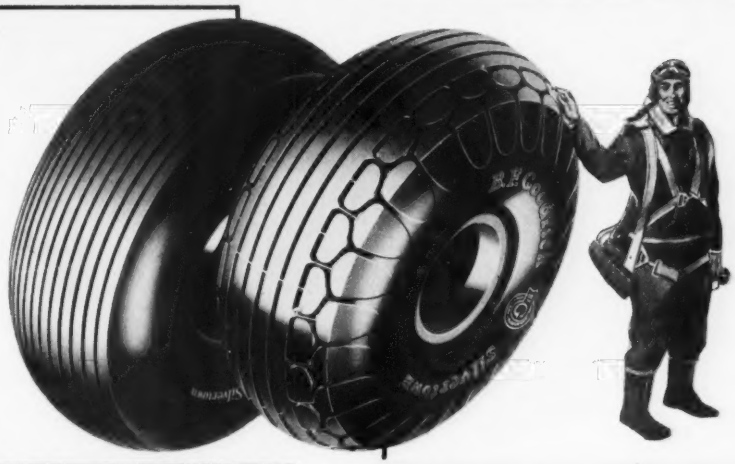
GIVE GREATER GROUND CONTROL

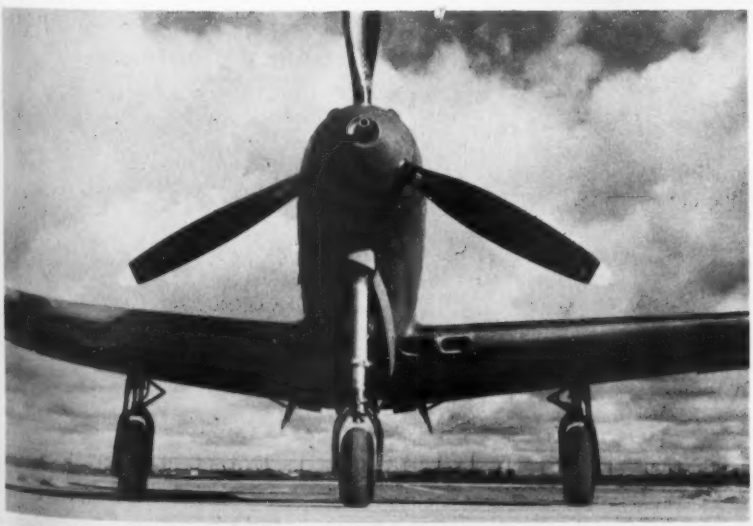
NO HOLDS BARRED! This new block tread design, developed recently by B. F. Goodrich for military use, will hug a macadam runway or a grassy field. This tread helps Uncle Sam's pilots stop safely, smoothly, quickly.



TESTING FOR TRACTION is a job to be done under actual operating conditions. Facts are obtained about the impact and action of tires on ground when a plane comes to earth. Skid, wear, and rate of deceleration are checked.



TWO SILVERTOWN TIRES with non-skid tread designs—the Safety Tread and the Ribbed Tread. Next time you fly with an airline, look at the tires on the plane. You'll probably see one of the treads shown here. B. F. Goodrich Tail Wheel Tires also come with these non-skid treads.



TRICYCLE LANDING GEAR causes a plane to land in a horizontal near-flying attitude. Therefore, it usually comes in much faster than does a plane with its tail down, making it necessary for the pilot to stop from greater speeds. That's why tires with non-skid tread designs are gaining new importance.

In war or peace

B.F.Goodrich

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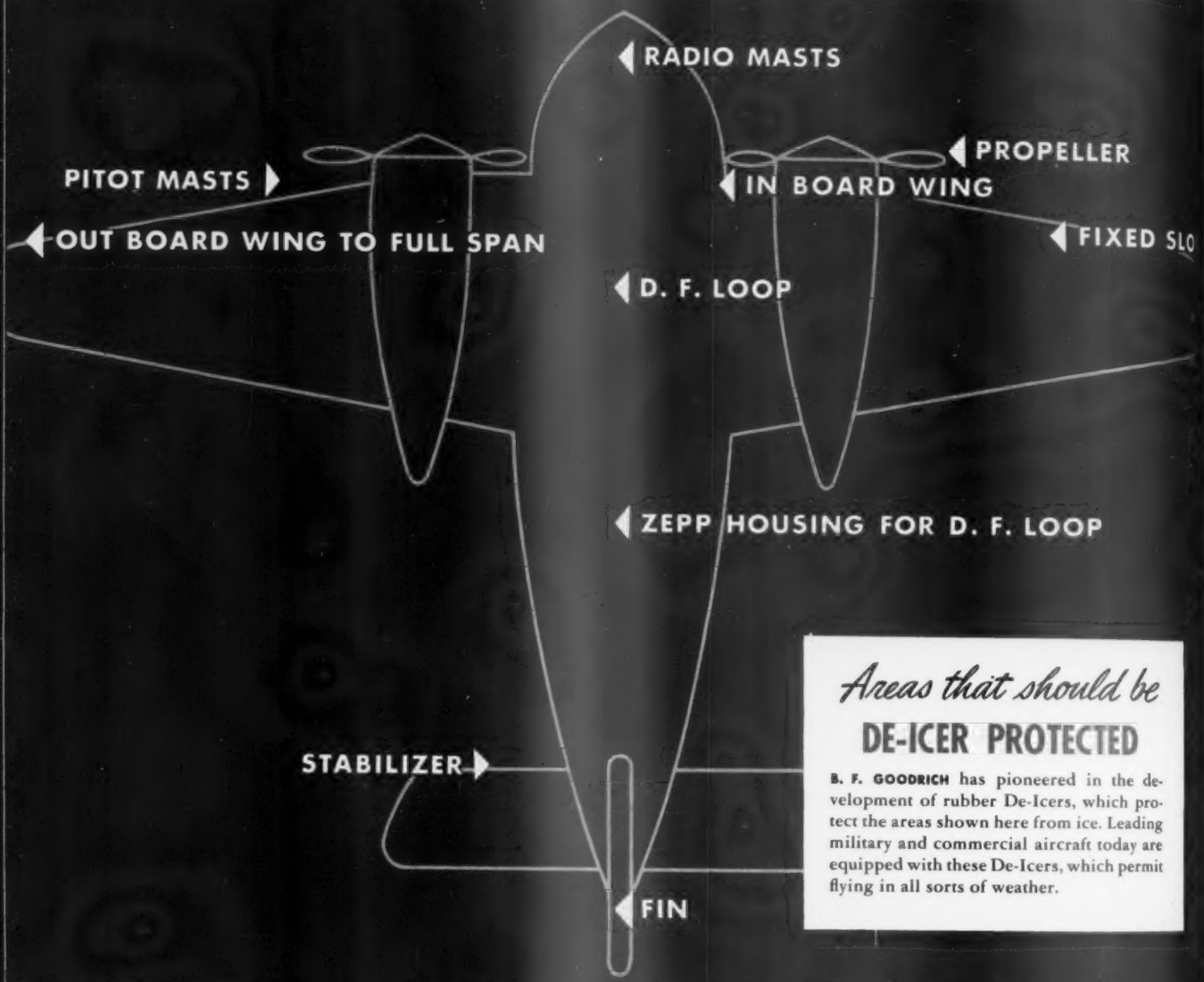
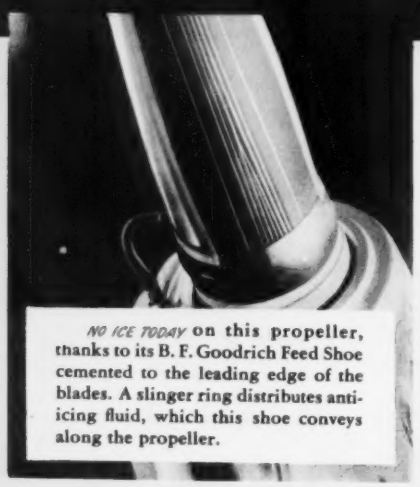
From the B.F. Goodrich *notebook*

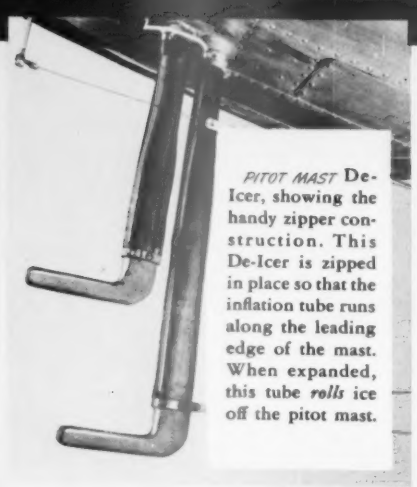


Areas that should be DE-ICER PROTECTED

B. F. GOODRICH has pioneered in the development of rubber De-Icers, which protect the areas shown here from ice. Leading military and commercial aircraft today are equipped with these De-Icers, which permit flying in all sorts of weather.



NO ICE TODAY on this propeller, thanks to its B. F. Goodrich Feed Shoe cemented to the leading edge of the blades. A slinger ring distributes anti-icing fluid, which this shoe conveys along the propeller.



PITOT MAST De-Icer, showing the handy zipper construction. This De-Icer is zipped in place so that the inflation tube runs along the leading edge of the mast. When expanded, this tube *rolls* ice off the pitot mast.

ABRASION SHOES made of rubber protect a plane's stabilizer and fins where fields are made of gravel and cinders. They also protect surfaces from cartridges ejected from the plane's guns which are carried back onto the plane by the slipstream.

B.F. GOODRICH AERONAUTICAL DIVISION AKRON·OHIO

It is indicated how the success of these missions depends on airplanes of great speed with a minimum chance of detection and on crews that have been extensively trained for this most exacting flying and photography. Their degree of success is demonstrated by the article's declaration that the Germans have never had the opportunity to examine one of these airplanes or cameras.

In addition to a description of the equipment used on these reconnaissance flights, the training of personnel is detailed. An explanation is also given of how the photographs are developed and interpreted, the various purposes for which they are used, and how photographic mosaics are pieced together from groups of them. *The Saturday Evening Post*, August 8, 1942, pages 20, 21, 86, 9 illus.

Plants

Organizing Plant Protection Against Enemy Raids in Time of War. The steps taken by the Fairchild Aircraft Company to protect its personnel and plant in case of an enemy bombing attack are recounted. An organization was set up to provide for immediate and essential equipment and supplies, and the training of plant personnel for an emergency. Subcommittees were appointed to cover property and material, protection and organization of workers, safety measures, first aid and fire fighting. Judging the cost to be prohibitive for the actual amount of risk involved, it was decided not to black-out the plant until actual need arose. Roof watchers were appointed and a public address system was installed through which plant-wide instructions could be issued. *Commercial Aviation*, July, 1942, pages 42, 70, 1 illus.

Plastics

Plywood Planes by the Vidal Process. P. M. Heidt. Describing the Vidal process for the manufacture of aircraft parts from plastic-bonded plywood. The process incorporates the use of wooden forms or molds on which a shell of plywood veneer is built up. Details of the process and the problems that had to be overcome in its development are discussed. Hardwood molds were found to give trouble from swelling and distortion during the curing process, but the use of softer woods solved this difficulty. Because the airtight bags in which the article to be molded is enclosed during the heat and pressure processes tended to tear and crack, a special material had to be developed for the purpose. Air is exhausted from the bag in order to apply the treated fabric of the bag to the plywood structure with uniform pressure. Heat and pressure are then applied for a definite period of time. Evacuation difficulties arose which required the invention of a suitable method for doing this. *Automotive and Aviation Industries*, July 15, 1942, pages 28, 29, 68, 5 illus.; "Airplanes and Bathtubs Cooked to Order," Paul Christian and Daniel G. Wittels, *Saturday Evening Post*, July 18, 1942, pages 12, 13, 36, 39, 7 illus.; "Molding Plastic Plywood," *Modern Plastics*, July, 1942, pages 46–49, 112, 114, 116, 11 illus.

Strength Characteristics of Plastic Bonded Plywood. The second installment of this article develops data on the value of Poisson's ratio for various species of wood. Solutions for the problems of concentrated loads are suggested, mention being made of new adhesives for bonding metal to metal or metal to wood. Tables are presented to show the basic strength of six aircraft woods and the relative strength of various materials including certain alloys and different woods.

In conclusion the writer summarizes the characteristics of various kinds of plywoods. The belief is set forth that with gluing technique developing at the present rapid pace, it will not be long before the application of a thin metal covering glued to a plywood core will be found in airplanes having extremely high wing loadings. *Aero Digest*, August, 1942, pages 140, 218, 1 illus.

Plywood Parts Offer War Jobs for Vast Woodworking Facilities. L. H. Meyer. An account is given of how the woodworking industry has made its facilities available for the construction of aircraft, thereby opening an important new volume of business for itself and its workers. Through the use of plywood and by means of extensive subcontracting, work has been provided for many small woodworking shops. They are making numerous complicated parts such as wings, fuselages, ailerons and others, in which a higher degree of precision workmanship is required than in the ordinary lines followed in the past. It is indicated that the conversion of woodworking shops and the use of bonded plywood for aircraft will continue. *Southern Flight*, July, 1942, pages 26, 27, 2 illus.; "Wood Is a War Weapon," *Popular Science*, September, 1942, pages 48–54, 14 illus.

Production

Jig and Fixture Details—1. John G. Jergens. Details of jigs and fixtures are shown in a series of drawings. The drawings include equalizing devices, leaf details, indexing pins and clamps, support jacks and vise jaws. In this first part of the article the drawings deal with equalizing devices utilizing the lever principle. They indicate the possible variations but are not represented as being complete. Blade type and screw equalizers are included, as well as those employing steel balls. *American Machinist*, July 9, 1942, pages 704, 705, 18 illus.

Cannon for Aircraft. The operations at one of the plants of International Harvester Company devoted to the manufacture of aircraft cannon are described. In exactly one year this plant was converted from a warehouse to a complete production unit. This was accomplished chiefly through the use of standard equipment from machine tool manufacturers. Few of the machines are special but have been adapted for their work by equipping them with proper cutting tools, jigs and fixtures. The gun components being manufactured are briefly described, with information on certain parts that are produced by other contractors and by other plants of the International Harvester Company. This is followed by a detailed description of the machines and the equipment of the plant and the operations carried out. There is an exposition of the methods by which the barrel is rifled and how the breech block is milled and ground. Operations on the bolt and lock are explained step by step, all of these explanations being accompanied by data on the machines used to accomplish this work. *American Machinist*, July 9, 1942, pages 717–729, 42 illus.

Rolls Apply Paint to Aircraft Parts. A continuous process known as roller coating is being employed by the Douglas Aircraft Company for painting aluminum sheets for aircraft parts. The six advantages of this process are set forth, including separation of painting from the work of fabrication, reaching all surfaces, eliminating necessity for spray guns for priming, uniform thickness of paint sections, speed, and economy of paint. The equipment used for this process is described. *American Machinist*, July 9, 1942, page 730, 1 illus.

V-Plan Saves Vital Metals. Carl J. Wiberg and Frank D. Kent. A description of Wright Aeronautical

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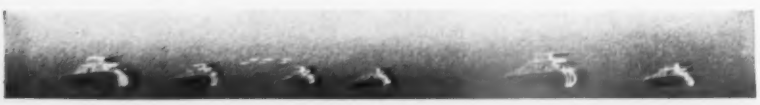

Corporation's system for the salvage and conservation of vital materials applicable to plants of any size. In preparing the system, emphasis was placed on avoiding the mixing of unlike metals and on the proper segregation of materials in order to obtain maximum recovery. Some alloys were grouped together in common lots, while others, such as those with a high nickel content, were held separate. Instructions to machine operators and chip men are printed on one side of 4 by 6 in. cards, the other side of which contains a large V in colors which constitutes a code followed throughout the plant. Details of this identification system are covered and factory methods are outlined. *American Machinist*, July 23, 1942, pages 761–763, 6 illus.

Aluminum Scrap. The importance of segregation in getting the most from aluminum scrap in order to provide all the aluminum needed in the victory program is emphasized. Because of the fact that aluminum is extremely difficult to reprocess once it has been contaminated with other metals or even other alloys, careful segregation of the scrap is essential for satisfactory results. Primary rules for setting up a good segregation system are given. Training the personnel is important, and the system must be tailored to fit the particular factory to which it is applied. It is also shown that good judgment in the buying of aluminum sheet will aid in the conservation program. *Automotive and Aviation Industries*, July 15, 1942, pages 37, 74.

Pontiac Concentrates on Oerlikon Anti-Aircraft Guns. Production of the Oerlikon rapid-fire antiaircraft gun, which is now coming off the assembly lines of the Pontiac Division of General Motors Corporation is described. To facilitate production the company concentrates on the manufacture of 22 of the major parts of this gun, 170 smaller components being produced by other concerns. The various machining operations are described in considerable detail and illustrated with photographs. About 85 per cent of all metal-cutting operations are done on milling machines, the rest of the work being distributed among drill presses, grinders and special boring, reaming, rifle drilling, and refiling machinery. The necessity for removing from 50 to 80 per cent of the total weight of parts proved a serious problem, especially from the standpoint of manufacturing time. Energy is being devoted to development of methods designed to speed up metal removal and to the redesign of certain parts to reduce the removal of metal. *Automotive and*

Aviation Industries, August 1, 1942, pages 20–24, 70, 12 illus.

Cold Pressing. J. G. Arrowsmith, K. J. B. Wolfe, and G. Murray. Because Duralumin alloys possess low ductility compared with the materials in more general use for cold-forming operations, only pressings of limited depth may be produced at a single forming operation, the writer explains. Pressings requiring a deeper draw may require intermediate softening operations. Distortion introduced by quenching prevents the carrying out of intermediate solution-heat-treatment except in those cases where the subsequent pressing operation is deep enough to remove the effects of distortion. Where the distortion is considerable, as with aircraft panels of large area and relatively shallow depth, it often cannot be removed by redrawing.

The writer points out that the small amount of distortion associated with spray quenching indicates this method could be applied advantageously to intermediate solution-heat-treatments. A general outline is furnished of the procedure that will prove successful for the majority of Duralumin-type alloy pressings, and a method of resolution-heat-treatment for more difficult pressings is described. *Aircraft Production*, July 1942, page 431.

A New Template Process. A new system of template preparation and reproduction evolved in England by E. S. and A. Robinson, Ltd., is described. It is designed to be applied at any desired stage between the approval of a wind-tunnel model and the completion of the original drawings. The apparatus works on the tracer principle. A combined scanning and drawing apparatus has been designed for use where drawings have not been prepared for the wind-tunnel model. Further details of the process are covered. *Aircraft Production*, July, 1942, pages 474, 475, 4 illus.

Rubber Die Practice. Based on information from the British Ministry of Aircraft Production, this article covers developments in rubber die technique for flanging, forming and blanking air-frame components. It is explained that the lighter metals, such as aluminum alloys now used in aircraft construction, require special treatment not necessary with steel and copper alloys. The special requirements of the aircraft industry have influenced metal-working processes. The use of hardened steel dies or tools is not justified where quantity output is relatively small, and modifications characteristic of aircraft design make the use of permanent tools impracticable. Substitute tool materials, such as compressed paper, fabric, rubber and cement compositions, have been developed to meet the new conditions.

(Left) Twin-engine Curtiss AT-9's and (right) single-engine Curtiss SNC-1's on the production line. The AT-9's are employed by the Army Air Forces to train pilots in operating high-speed, multiengined bombers. The SNC-1's are used by the Navy for providing fighter pilots with advanced training.

It is stated that aluminum and some of its alloys tend to "drag" when pressed in steel dies. The trouble is due to excessive friction between the metal surfaces. With rubber dies this trouble is not encountered because the tool is softer than the metal. In discussing the principle upon which the use of rubber for dies depends, the writer explains that while rubber is easily deformed it regains its normal condition without appreciable permanent set. In application, a rubber pad is housed within a steel container strong enough to withstand the total bursting pressure due to the working pressure on the platen. The thickness of the die should be about two-thirds the depth of the container. The writer continues with a discussion of rubber properties, types of dies, combined shearing and forming, drawing operations, platen pressure, and pressure specifications. *Aircraft Production*, July, 1942, pages 469–473, 14 illus.

Thunderbolts to Smite the Axis. Hans E. Lasker. Short cuts, improved procedures and streamlined methods that contribute to the quantity production of Republic P-47 high-altitude fighters are described. Simplification of design makes possible the large-scale subcontracting upon which the manufacture of these airplanes is based. For assembly the fuselage is split in half horizontally from the forward bulkhead back to the conical tail section. This offers the advantage of permitting various assemblies and fittings to be installed before the splice is made. *Aviation*, August, 1942, pages 100–105, 269–270, 9 illus.

Castaloy Fixtures Unify Aircraft Production. Chester S. Ricker. An explanation of the uses of Castaloy Corporation's products for the accurate duplication of airplane parts. Metal model replicas, gauges and assembly fixtures made by this company are said to assure complete interchangeability of parts for aircraft production. Metal-clad fixtures or tools are used for drilling, gauging, checking, inspecting and verifying contours of parts. Where shapes and contours of parts are irregular, these fixtures are judged to be particularly valuable. Information is also given on Cerrobend, an alloy with low-temperature melting point, developed by this company. *Aviation*, August, 1942, pages 106–109, 12 illus.

Reclaim Rubber for Aircraft. Stanley S. Kogut. To help relieve the rubber shortage it is urged that reclaim rubber be used in aircraft production wherever possible. This article surveys applications in which rubber reclaim stocks, instead of crude or synthetic rubber, can be used to advantage. Among the uses in aircraft manufacturing to which reclaim rubber is thought particularly adaptable are: for seals to close openings where leakage of air may occur; for electrical insulation purposes, hand grips, knobs, and pedal controls; for cabin flooring, walkways, and battery cases; and for certain types of grommets. *Aviation*, August, 1942, pages 122, 123, 293, 294, 297, 5 illus.

Induction Heating for Aircraft Production. J. Wesley Cable. Wider applications of the induction heating process, particularly in the aircraft industry, are explained. Although the principle of thermionic heat induction is not new, the modern method of converting ordinary commercial electric power into high frequencies and applying it as controlled localized heat for surface hardening, brazing, melting, annealing and other heat-treatment has numerous advantages in aircraft production. Borrowed from an established procedure in radio broadcasting, the principle permits the conversion of electrical energy into heat energy which is so accurately controlled that although the heat is intense it does not alter the metallurgic properties of adjacent parts.

An explanation is given of the phenomenon that occurs when high-frequency current by induction is used for hardening and other metal processes. Numerous uses of the method in the production of airplanes include internal hardening of engine cylinders, hardening of gears, brazing aircraft wiring harness assemblies, hardening spark plugs and magnetos, and for hardening and expanding ball-bearing races. In fabricated struts for aircraft, work with induction heating is said to be still largely experimental, but progress is being made in its use with silver brazing alloy. Experiments also indicate that induction heating of prefabricated steel propellers will be advantageous. The thermionic generator is portable and operates with small maintenance cost. *Aviation*, August, 1942, pages 127, 128, 2 illus.

New Drill Cuts Production Time. F. S. Gepfert. Examples are cited of several operations in airplane engine plants in which time is being saved and rejects substantially reduced by the use of "Hardsteel" drills. For drilling oil holes through the connecting-rod bearing surfaces, the new drills permitted a revision of shop practice so that drilling could be done after hardening, avoiding the distortion that caused many rejects. In another plant, external and internal distortion trouble in camshafts was eliminated by making possible the hardening and finishing operations before drilling. A third instance was in the drilling of camshafts for in-line aircraft engines where the shaft was rifle-drilled before hardening, leaving an extra inch for a duck grip which was later ground off. The new method permits machining after hardening, using the drill to cut away the final inch, instead of a costly grinding process to remove it. A slow and costly grinding operation in a fourth plant was eliminated in the manufacture of push rods through the ability of the drill to penetrate the hardened steel surface in 5 sec. *Aviation*, August, 1942, page 130, 2 illus.

They Learn by Doing. E. H. Worthington. Some details on the way Curtiss-Wright educates its subcontractors for their part in the manufacture of aircraft. A two- to five-week period of intensive training for subcontractors' representatives has been instituted by this company. After a quick indoctrination and a few lectures by plant executives, the trainee learns to make the part by practical application and actual practice. The educational plan also provides for a follow-up by Curtiss lead men after the trainee has set up production in his own plant. *Aviation*, August, 1942, pages 179, 180, 183, 3 illus.

Use of Carbides on Large Machines. Fred W. Lucht. Present-day demands for increased output have made it necessary to restore to service many older types of machine tools which were not originally designed for high-speed operation. For this reason little attention has been given to the use of carbide tools with large machines of this type. However, it is stated that there is no fundamental reason why carbide tools cannot be applied successfully to most larger machines, especially those of somewhat newer design which are built with greater rigidity. Factors that have contributed to broadening the use of carbide tools are the increased knowledge of proper speeds and feeds, improved clamping fixtures, better determination of shank and tip sizes and increased knowledge of tool shape and cutting angles. Other factors are listed, along with the advantages of the use of carbide tools on large machines, these being set forth under six headings. Improvements in shop practices are also suggested as a result of this application. *Aero Digest*, August, 1942, pages 156, 191, 3 illus.

Condensed Schedule for Shop Use. Charles H. Brown. Solutions are suggested for the problems involved when unexpected incidents interfere with the carefully drawn up schedules of aircraft planning departments. The shop order is held to be the most important factor involved. A condensed schedule is submitted with an explanation for its use. *Aero Digest*, August, 1942, page 159, 2 illus.

Handling Equipment for Speeding Aircraft Production. Leslie V. Spencer. It is related how modern methods of handling heavy and bulky equipment have been adopted to facilitate increased production in aircraft plants. Numerous types of conveyors are described, with information on the specific problems that they are intended to overcome. Installations in leading aircraft plants are cited as examples. Another mechanical device that is rendering an important service in the handling of aircraft materials and finished parts is the crane, on which detailed information is presented. Industrial trucks and tractors are also used in many important plants, these mechanisms having been found suitable for use where such permanent installations as conveyors and cranes cannot be readily used. The basic forms of trucks and tractors are shown, with the variations necessary to meet the special problems found in aircraft plants. Hoist and miscellaneous handling devices are also included. *Aero Digest*, August, 1942, pages 197, 198, 201, 202, 205, 206, 209, 210, 213, 335, 336, 338, 339, 36 illus.

Canadian-Built Aircraft Slated to Make Common Destiny with Royal Canadian Airforce. The salient points in the manufacture of Bolingbroke bombers by the Fairchild Aircraft Company in Canada are reviewed. In relating the separate construction of the various parts of the plane and their subsequent assembly, the use of wood in this all-metal aircraft receives comment. Although built in Canada, the Bolingbroke is powered by an engine imported from England —the Bristol Mercury. *Commercial Aviation*, July, 1942, pages 32, 34, 38, 40, 9 illus.

Constructional Details of Canadian Fairchild Bolingbroke Bomber. Information on the 3,000 specifications and 80,000 parts that go into the manufacture of the Bolingbroke Mark IV, British long-range reconnaissance bomber. Designed to be operated as a landplane, the Bolingbroke is convertible for use on floats and skis. With the exception of the control surfaces, it is of all-metal construction and is powered by two Bristol Mercury XV engines. The article considers separately the fuselage, empennage, landing gear, power plant, deicing system, bomb-carrying capacity, and crew facilities. Other parts particularized are the main flight controls, control column, rudder pedals, elevator tabs, rudder tab, and aileron tabs. Principal dimensions of the airplane are presented in tabular form, as well as specifications on the wings, ailerons, flaps, empennage, main undercarriage, tail wheel, engines, propeller, fuel system, oil system, and engine accessories. *Commercial Aviation*, July, 1942, pages 44, 46, 48, 5 illus.

Cutting Production Time with Automatic Spray Robot for Painting Aircraft. A description of the automatic spray process used by the Glenn L.

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Working day and night, without pattern or precedent in an infant industry, ingenuity and engineering skill were severely taxed to perform "impossible" tasks. New production methods had to be devised—parts and assemblies designed as well as the tools and equipment that were required to produce them.

Then came the building of an organization—the gathering together of thousands of men and women, strangers to each other—unskilled in the work they were about to do—yet eager for the tasks at hand.

Training—intensive training—was the order of the day, training in the handling of machines and tools, training that would form the habits and customs of a new-born industry.

How well this job has been done is indicated by the rising and fighting power of Airacobra Squadrons in our fighting forces and from the high praise that comes back from fighting fronts. © Bell Aircraft Corporation, Buffalo, New York.

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FUTURE PLANES FOR PEACE

BELL *Aircraft*

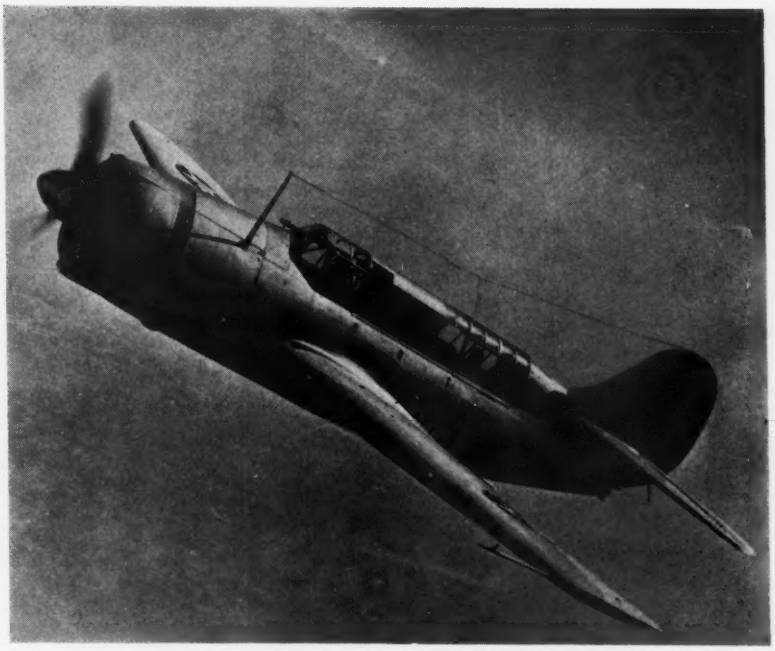
PACEMAKER OF AVIATION PROGRESS

Martin Company for painting various parts of Martin bombers. The mechanical spray gun is built in two banks, or cycles, and works on an endless belt system. To adapt it to aircraft work several refinements have been made. One such improvement is a stack and ventilator arrangement that prevents fine particles of paint from being drawn out through the stack into the air. Other changes include the addition of two hand-spray booths on each cycle of the machine and alterations in the drying oven. *Commercial Aviation*, July, 1942, page 86, 6 illus.

Canada's Warplane Industry. James Montagnes. Facts are given about the growth of Canada's aircraft industry. It is stated that from a minor industry in 1939 it has now grown to the point where it assists the United States in meeting lend-lease obligations. Supplemented by brief descriptions of each plane, a report is made on the production statistics for individual airplanes being manufactured in Canada. This list consists of the Handley Page Hampden medium bomber, Vickers Stranraer flying boat, Consolidated PBY Catalina flying boat, Bristol Bolingbroke reconnaissance bomber, North American Havard advanced trainer, Hawker Hurricane fighter, Fleet Finch and Fort trainers, de Havilland Moth elementary trainer, Avro Anson reconnaissance bomber, Avro Lancaster heavy bomber, Curtiss Navy dive bomber, and several others. *Flying and Popular Aviation*, August, 1942, pages 32–34, 8 illus.; "Canada's Aircraft Industry," *Aviation*, August, 1942, pages 96, 97, 259, 260, 5 illus.

Tubular Rivets for "Blind" Work. J. J. Russell. An explanation of the use and purposes of a new type of rivet and method of application developed by the Canadian Car and Foundry Company in cooperation with the United-Carr Fastener Company of Canada. At the rate of 110 a minute, the rivet is stamped out of strip stock in an automatic eylet machine. It is slipped on a commercial nail of plain carbon steel weakened under the head. The shank of the nail is used as a mandril. In fastening, the nail with its attached rivet blank is slipped into the rivet hole from the front side of the section to be fastened.

This type of rivet is primarily used for those sections of the frames, wings, and fuselage where it is difficult to work with a holding "dolly" or bar. Some of the advantages claimed for it are that: (1) it can be more speedily driven in blind spots than solid rivets; (2) its cost is relatively lower; (3) because of its automatic operation it does not require experienced help and eliminates the possibility of human failure; (4) it facilitates repairs to airplanes in zones of operation; (5) it speeds up construction of fabric-covered training planes; (6) it helps to eliminate waste of metal. *Canadian Aviation*, July, 1942, pages 43, 44, 6 illus.



The new Curtis Helldiver divebomber. This two-place, all-metal, mid-wing monoplane is powered with a 1,700-hp. Wright Cyclone engine and is said to be capable of carrying heavy bomb loads farther and faster than any dive-bomber type now in service.

A Nerve Center of a Vast Industry. Florence O. Bergstrom. This is a description of what the writer saw in a tour of certain plants of the United Aircraft Corporation. One of those visited was the Hamilton Standard Propeller plant at East Hartford, Conn. Machine operations in the production of propellers are discussed.

The Pratt & Whitney engine plant was also surveyed. Here the conveyor system devised to carry parts from one section of the plant to the other was studied. Production operations in this plant as observed by the writer are described. *U.S. Air Services*, August, 1942, pages 21, 24, 42, 1 illus.

Propellers

Steel Airscrew Blades. After outlining the advantages of steel airscrew blades, detailed information on the manufacture and repair of the Curtiss hollow type is furnished. For some time it was thought that steel airscrews—an American introduction—could not be repaired. The article covers a successful repair technique that has been developed. It is stated that, while under normal operating conditions steel blades would have a life probably greater than that of the aircraft, in wartime the emergencies of civil aviation—such as damaged undercarriages necessitating crash landings—become almost commonplace and involve problems of propeller shortage when blades cannot be repaired. Procedure for the removal of scratches straightening of blades, inspection, testing for cracks and final balancing is covered. *Aircraft Production*, July, 1942, pages 446–451, 17 illus.

Radio

German Radio Equipment. Official British reports are given on the radio installations in the German Messerschmitt Me 109 and Junkers Ju 87, as issued by the British Ministry of Aircraft Production. The type FuG radio equipment in the Messerschmitt Me 109 is described and a detailed report is presented on its construction and operation. Its specifications are set forth and a lengthy description follows of the receiver, transmitter, and power supply. The performance of the instrument is charted and tabulated and circuit diagrams are reproduced.

In a similar manner information is furnished on the type FuG 7A, giving the details of installation. *Aircraft Engineering*, June, 1942, pages 164–167, 10 illus.

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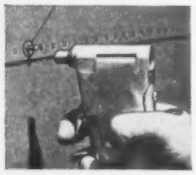
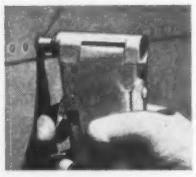
HOW TO REMOVE THE INSPECTOR'S CIRCLE

1 Remove the rejected rivet in the normal way by drilling.



2 Insert the next size larger Cherry Blind Rivet. This may be done by placing the rivet in the hole first, as shown here, or by placing the rivet in the gun head.



3 With gun in position, depress the trigger. The heading operation is completed instantly. Projecting mandril breaks, releasing gun.

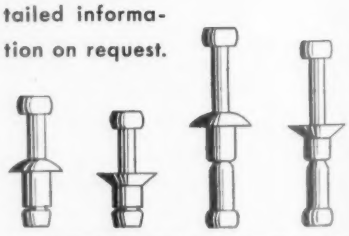
4 Flat-ground nippers remove the remaining portion of the pulling mandril. The job is finished in less time than it takes to show you these steps.

From left to right, the hollow type with brazier and countersunk heads — the self-plugging type with both styles of heads. All are applied with either the hand or power gun.

4 Easy Steps with Cherry Blind Rivets

The inspector's circle, indicating a rejected rivet, can be a very expensive mark unless you replace with Cherry Blind Rivets. This rivet eliminates the time-consuming and costly step of removing inner skin to gain access to the blind side because it heads itself on the blind side.

The Cherry Rivet is applied with a special gun which pulls on the mandril and pushes on the rivet head forming a tulip head on the blind side, expanding the shank and permanently plugging the rivet. This positive mechanical action assures the formation of a satisfactory head on the blind side. Detailed information on request.



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PHOTOS COURTESY ANDERSON AIRPLANE SCHOOL

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Driver's Seat. W. W. Macdonald. How the needs of the aircraft industry have recently influenced the radio field is indicated. Military requirements have brought about many improvements in the design and construction of radio parts and instruments to meet the exacting duties expected under war conditions. Consideration is given to the technical necessity and economic feasibility of continuing some of the design improvements after the war, and speculation is offered concerning the nature of radio parts and equipment for peace time use. *Aviation*, August, 1942, page 219, 1 illus.

Radiotelephone Procedures Used by Pilots When Communicating with Airport Control Towers. Part two of a series of articles dealing with air traffic control in Canada. This installment covers the procedures used by the Department of Air Transport Service to control aircraft equipped with two-way radio. Pointers are given on speech technique, use of microphone, direct communication, radiophone procedure for outbound aircraft, runway numbering, take-off points, inbound flights, and "raising" ground stations. *Commercial Aviation*, July, 1942, pages 52, 56, 58, 60, 62, 64, 104, 12 illus.

Research

Pinned-Pinned Slender Solid Struts with Parabolic Taper. F. J. Turton. This paper discusses one of the few cases of elastic stability of struts, in which the tapered profile of axial longitudinal sections is part of a parabola, giving a "homogeneous linear" differential equation. The pinned-pinned strut is the only case considered in this paper, it being regarded as important because it makes possible a saving in weight and air resistance as compared with a uniform strut of equal strength and having similar transverse sections. An indirect saving is also possible by the use of smaller end fittings. It is stated that the solution can be applied to effect a similar saving in weight and air resistance for two types of strut designated as (a) a clamped-free strut, corresponding to one-half of the pinned-pinned strut and (b) a clamped-clamped strut, of which the middle half corresponds to a pinned-pinned strut. The writer states that parabolic taper with a clamped-pinned strut does not effect a saving in weight.

The mathematical problem is discussed, the relation giving the critical load is found and the method of solution is explained. An expression is then found for the saving in weight and results are quoted for the strut with no uniform central portion. Graphs are presented from which the strength of the strut and the saving in weight can be read and compared with results obtained with other forms of taper. *The Journal of the Royal Aeronautical Society*, June, 1942, pages 146–151, 3 illus.

Heat Transfer to a Fluid in Laminar Flow Through an Annular Space. Max Jakob and Kenneth A. Rees. A theory is developed for the transfer of heat between the walls of an annular space and a fluid passing through that space in laminar flow. Cases of uniform heating or cooling from the outside, the inside or from both sides at the same time are considered. Constant properties of the fluid and linear temperature change in the length direction of the annulus at any point of the cross section are assumed.

Representations of the results of uniform heat transfer can be set forth in either of two ways: the relationship of a film coefficient of heat transfer to one of the radii of the annulus and to the heat conductivity of the gas; or by the ratio of the temperature difference between the walls of the annulus and the temperature change in axial direction. The writers have chosen the first kind of representation for the case of heat transfer at one wall only, and the second was selected for the case of heat transfer on both walls where no unique coefficient of heat transfer can be defined. The resulting equations are evaluated and tables and graphs are presented for practical use.

Experiments have been made to check the theory, in which ethylene, hydrogen and air, flowing in a long and narrow annulus, were heated from the outside by electrical coils. It was found that up to about two per cent of the heating energy crossed the annulus by radiation and reached the gas from the inner wall. In the experiments the range of Reynolds Numbers was Re = 50 to 1,000, where the average velocity and the kinematic viscosity of the gas had certain values by definition. The experiments gave some deviations from the theoretic values for laminar flow conditions, but it is stated that these individual differences may originate from a temperature correction of restricted accuracy and the increase with Reynolds Number may originate from transition to turbulence. Difference between the combined average value of 3.99 for the three fluids, and the theoretic value of 3.52 may be ascribed to eccentricity of the two tubes of the annulus. Since the heat conductivity of hydrogen is seven times that of air and ten times that of ethylene, the agreement of the experiments and theory is regarded as satisfactory, despite the deviations mentioned. *Illinois Institute of Technology, Research Publications*, May, 1942, pages 203–229, 6 illus.

New Research Facilities for NACA in Three Strategic Locations. The rapid expansion of the research facilities of the National Advisory Committee for Aeronautics is revealed in this article. It opens with a brief outline of the history and early activities of the committee which was organized in 1915. Expansion during the past year includes additions to the original laboratory at Langley Field, Va., opening of various units of the new Ames Aeronautical Laboratory at Moffett Field, Calif., and the beginning of construction work on the engine research laboratory at Cleveland, O., one unit of which already is in use. The remaining three units of the $18,000,000 Cleveland laboratory will be placed in service before the end of this year. Major research facilities at this laboratory will include an engine-research building, an engine-research wind tunnel, a fuels-and-lubricants building, an engine-propeller research building, a flight-research hangar, and an ice tunnel. Research activities to be carried out in these buildings are outlined.

Efforts will be directed toward increasing the power output of engines, which, it is pointed out, must be about doubled without material increase in engine size in order to attain aircraft speeds up to 500 m.p.h. The facilities for increasing the efficiency of superchargers, the wind tunnel that makes available air speeds far in excess of present airplane cruising speeds and the laboratory for the study of fuels and the reduction of detonation will be important aids in connection with this undertaking.

New wind tunnels built at Langley Field and Moffett Field represent an expansion of more than 100 per cent in this type of facilities, and other wind tunnels under construction will provide an additional 100 per cent increase. The article also discusses how the laboratories are aiding in the development of military aircraft in connection with the war program. *Automotive and Aviation Industries*, July 15, 1942, pages 24–27, 64, 8 illus.

An Oil Corrosion Tester. Neil MacCoull, E. A. Ryder and A. C. Scholp. This paper describes a simplified apparatus for testing the corrosiveness of lubricants as indicated by their tendency to corrode bearings. The results of tests made with the apparatus correlate satisfactorily with engine tests. Because other factors tend to affect the correlation, the necessity for engine tests is not eliminated, however. Since a number of samples can be rated quickly under a variety of conditions, and the corrodibility of

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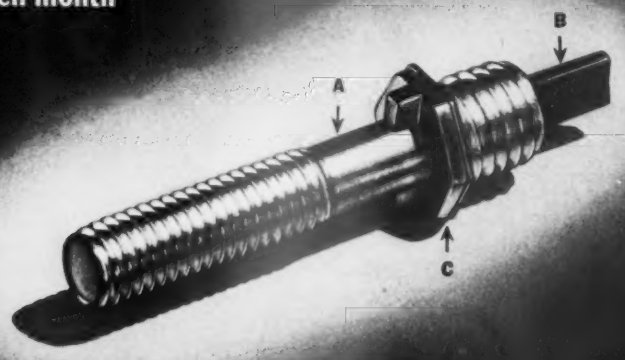

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bearing metals or the corrosiveness of oils can be predicted approximately, the number of engine tests can be reduced. It is stated that Pratt & Whitney Aircraft Division is now using this apparatus to distinguish between good and bad oils for engines in testhouse service with entire satisfaction. Development of the apparatus and the testing methods used are covered in detail. *S.A.E. Journal*, August, 1942, pages 339–345, 16 illus.

Rotating Wing Aircraft

Some Side-Lights on the Operations of Helicopters in Future Non-Scheduled Flying. A reprint of suggestions submitted by Igor Sikorsky to the Civil Aeronautics Board's Safety Bureau for the possible revision of the Civil Air Regulations as they would apply to helicopters. Based on his experiments with the VS-300 these suggestions reveal several constructional and performance characteristics of this type of aircraft. The fundamental changes in regulations recommended pertain mostly to flight altitudes, clearance below or above cloud levels, and visibility minimums. *The Sportsman Pilot*, July 15, 1942, pages 8, 9, 32.

Stress Analysis

A Theory for the Buckling of Thin Shells. Hsue-Shen Tsien. In a series of papers written by the present writer in collaboration with Th. von Kármán and Louis G. Dunn, the effect of curvature of a structure on its buckling characteristics was investigated. The purpose of these investigations was to find an explanation for the discrepancy between the "classic" theory and the experiments. For the case of a thin spherical shell under external pressure and for the case of a thin cylindric shell under axial compression, equilibrium states involving large deflections are discovered which can be maintained by loads far less than the so-called buckling load calculated by the classic theory of infinitesimal deflections. It was felt then that since some of these newly found equilibrium states closely approach the observed phenomena the shell must "jump" suddenly from the unbuckled configuration to these equilibrium states and the structures fails as a result of this sudden change. However, the reason why the shell should jump to these particular equilibrium states and not others was not explained. In the present paper a new principle involving the energy level and the geometric restraint is developed to determine this sudden change in equilibrium states. By means of this new principle the buckling load of both the spherical shell and cylindric shell can be calculated. The agreement with experiments is good. *Journal of the Aeronautical Sciences*, August, 1942, pages 373–384, 20 illus.

The Importance of Stressing. F. R. Shanley. Explanations are presented in nontechnical language of some of the aspects of stress analysis. This article tells how the properties of various materials are investigated and tested for the effects of stress. Such forces as vibration, fatigue and impact are analyzed and illustrated by examples of an everyday nature. Instructions are quoted for the prevention of failure of metals under stresses. *Western Flying*, July, 1942, pages 47, 64, 5 illus.

Superchargers

The Exhaust-Driven Supercharger. A series of four articles on the design and construction of exhaust-driven turbosuperchargers, collected from various sources is presented. The first article, "Exhaust Turbine Superchargers," by A. Meldahl, deals with mathematical considerations, and is taken from *The Brown Boveri Review*. From a mathematical analysis, graphs are obtained for calculating altitude supercharging of an internal combustion engine under three conditions: (1) where the air is cooled to an initial temperature after passing through the blower; (2) where air is not cooled after compression and there is a constant pressure cycle; and (3) where air is not cooled under compression and there is a constant volume cycle. The section ratio of the nozzle is determined, after which it is possible to compare the pressure of the gas before and after it enters the engine. A graph shows the amount of supercharge necessary to maintain engine output at various altitudes, both for a constant pressure cycle and constant volume cycle. The effect of altitude and variations in engine speed are discussed.

The second article is "A German Survey," by Werner von der Null, R. T. P. Translation No. 1445 (by L. J. Goodlet), from *ZVDI*. This provides a summary of most of the experiments on exhaust-driven turbosuperchargers that have been made in various parts of the world. Utilization of engine exhaust energy is the best means of obtaining maximum fuel economy in high-altitude flight, it is stated. The difficulty is to obtain turbines of sufficiently light construction for operation at gas temperatures between 800° and 1,000°F., and running speeds of 20,000 to 30,000 r.p.m. Despite much research, development still is in the initial stages. Research problems connected with supercharging are discussed in detail. The latter part of the article covers turboblowers for aircraft Diesel engines.

In the third article, "American Experience," by Sanford Moss, a nonmathematical picture is drawn of exhaust turbine superchargers developed in America, with special reference to research work carried out by the General Electric Company. The writer outlines the turbosupercharger cycle with the aid of a diagram. Other subjects covered include supercharger regulation, scavenging with exhaust-inlet valve overlap, and supercharger efficiency. Power curves for engines with turbosuperchargers and two-speed gear superchargers are shown.

The fourth article is "Properties of Materials Available," by H. Zschokke, and is taken from *The Brown Boveri Review*. The writer draws attention to the importance of recent investigations on construction materials with reference to the development of gas turbines. Steels of high creep limit should be available to the designer, who should be familiar with their behavior at high temperature. The length of time during which a material can be subject to a stress is another important consideration. *Aircraft Engineering*, July, 1942, pages 182–195, 46 illus.

Superchargers. H. E. Linsley. In nontechnical language, the functions of superchargers are explained. The operations of single-speed, two-stage and turbosuperchargers are briefly outlined, with comments on the conditions under which they are used. *Air Trails*, August, 1942, pages 20, 42, 4 illus.

Testing Equipment

Residual Method of Magnaflux Testing. M. L. Mages. A comparison of the residual and continuous methods of Magnaflux testing recites the specific advantages and limitations of the residual method. Where applicable and properly used, the residual method is credited with the following advantages: The magnetizing equipment becomes less complicated and consequently less costly; the speed of testing is greatly increased as the magnetizing can usually be accomplished as fast as the parts can be placed into and removed from the Magnafluxing unit; any number of inspectors can be used in locating the actual indications, thereby saving time, whereas with the continuous method the men operating the Magnaflux unit must necessarily do the inspecting. The conclusion is drawn that in testing aircraft engine parts the residual method will reveal any

indications serious enough to cause rejection, with the exception of wrist pins. Choice between the methods is determined by the magnetic retentivity of the parts to be tested. For deep subsurface indications the use of more sensitive methods is advised, such as the wet continuous or continuous with dry magnetic powder. *Aviation*, August, 1942, pages 118–120, 255, 6 illus.

Tools and Equipment

Plastics in Aircraft Tooling. Innovations by the Lockheed and Vega aircraft corporations in the use of plastic for drill jigs and forming dies are described in detail. These plastics are reported capable of standing up to 8,000-lbs. pressure per sq. in. under hydropresses. Their use, said to result in a great economy of time and vital materials, was motivated by the idea that drill jigs can be fabricated by securing the drill bushings to the master part, placing the part in a form, and pouring a molding of material around it. When the material has solidified in conformity to the contour of the part, the bolts holding the bushings in position can be removed and the jig then finished. *Canadian Aviation*, July, 1942, pages 39–42, 54, 8 illus.

Training

Briggs Aircraft Training Program. John W. Busman. The training procedure developed by an air-frame contractor to instruct unskilled labor personnel is detailed. On a miniature scale the company's school is fashioned after a production department, using the same types of jigs and fixtures. Practical instruction is combined with the theoretic by its combination of instructors, half of whom were selected from the plant's original skeleton crew of skilled operators, the other half from the aircraft-engineering field. After an induction test, accepted novitiates go through a series of training steps beginning with exercise projects, followed by practice in drilling off rivet heads and punching out rivets, work on actual airplane parts, and then into the duct department where among other things they learn to use the drill, trim, and assembly jigs. The course, however, is based mainly on specialized training which proceeds from this point on. *Aero Digest*, August, 1942, 108, 112, 114, 218, 8 illus.

Wings in Palestine. Emphasizing the geographically strategic importance of Palestine to international air routes, this article surveys the various methods by which Palestinian youth are being trained to build up a flying personnel potential. Model-building classes as part of the regular elementary school curriculum, gliding clubs, and flying clubs are some of the phases of the attempt to form a nucleus of air-trained men in the Middle East war sector. The article also suggests the extension of the British Air Training Corps organization to include Palestine and other parts of the Empire, pointing out the advantages to be derived from such a plan. *Flight*, June 18, 1942, pages 611–613, 6 illus.

Swank School. Rowland Carter. An account of how Miami Beach was quickly converted into a training center for nonflying officers of the Army Air Forces. The article surveys the instruction, physical care, quartering and hospitalization of the men and shows how the facilities of resorts, used to accommodating crowds of people, are particularly adaptable for military use.

The officers being prepared at Miami Beach are those required for such phases of Army duty as transportation, supply, mess, and personnel administration. Instruction is divided into three major training operations. There is the officer candidate school, the officers' training school for men already commissioned, and the replacement training center for enlisted

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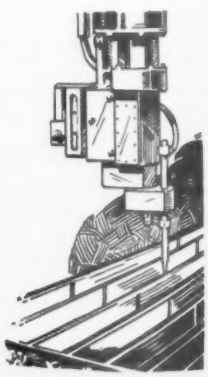

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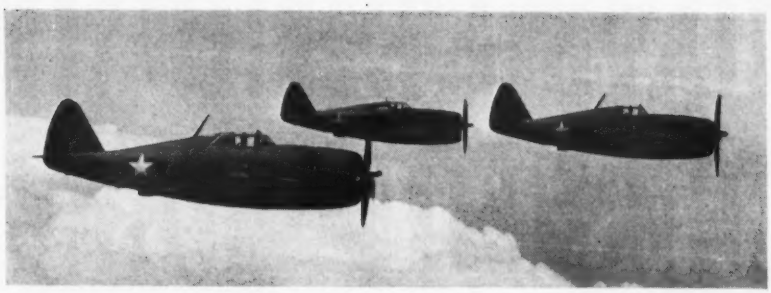
recruits. *Flying and Popular Aviation*, August, 1942, pages 38–40, 109, 110, 3 illus.

The "Air-Conditioned" Generation. John W. Studebaker. The United States Commissioner of Education discusses the responsibility of primary and secondary schools in making aviation training an integral part of American youth's early education. He claims that the public high schools are already embarked on a program that will contribute substantially to the speedy expansion of the air forces by helping build up an adequate potential of qualified candidates for training as flyers; that they are also looking to the future in reshaping the study and training of students in secondary schools to give full recognition to the importance of aviation in modern life. As examples, he shows how the study of aeronautics can be integrated into various elementary and secondary school subjects such as geography, mathematics, physics, history, and industrial arts.

The article also outlines the extra-curricular aviation courses that are being given. It explains, too, the purposes of the National Advisory Committee on Aviation Education and the objectives that the educational authorities have set for themselves. *Flying and Popular Aviation*, August, 1942, pages 41, 94, 95, 1 illus.

Desert Pilots. Charles E. Planck. This article relates how the operators of 54 flying schools, engaged in the Civil Aeronautics Administration pilot training program, overcame the difficulties entailed in the government order requiring such schools to move inland a distance of at least 150 miles from the Pacific coast. It was first necessary to locate adequate flying fields and many difficulties were encountered in moving the equipment and personnel. Hangars, shops and living accommodations had to be provided, in many cases, in small communities in the desert. Hardships were encountered both physically and financially by the students, instructors and Civil Aeronautics Administration inspectors who had to acclimate themselves to living conditions much more severe than those to which they were accustomed. Financially, also, hardships were encountered because living costs were found to be much higher in the desert towns. Moreover, Civil Aeronautics Administration personnel were limited to their fixed incomes and the operators were unable to vary the terms of their government contracts to compensate them for the increase in expenses. *National Aeronautics*, July 1942, pages 20, 21, 35, 3 illus.

Gen. Weaver Has Vital Task. Importance of the services performed by the Army Air Forces Technical Training Command under the direction of Major Gen. Walter R. Weaver is stressed. The organization of the unit is described, as well as the courses offered. *Dixie Air News*, July, 1942, pages 7, 31, 32, 1 illus.



Republic P-47 Thunderbolts. These high-altitude fighters are powered by Pratt & Whitney 2,000-hp. engines equipped with turbosuperchargers.

"Annapolis of the Air" Holds to 28 Year Tradition. Changes and innovations recently made in the training work of the Naval Air Station at Pensacola, Fla., and its associated stations and preflight training schools at various colleges are reviewed. The work performed by the cadets is followed to the award of the commission to the graduate. *Dixie Air News*, July, 1942, pages 20, 21, 2 illus.

Winged "O." The duties of an air observer are reviewed and the training received by R.C.A.F. air observer recuits is outlined. It is stated that the navigator, or air observer, is the key man in a bomber and that his task consists of guiding the bomber to the target, aiming and releasing the bomb for the target, and directing the bomber back to its home base. The equipment used for both the bombing and navigating aspects of his job is noted. *Canadian Air Cadet*, June-July, 1942, pages 10, 11, 3 illus.

G-2. The vital importance of cooperation and teamwork is stressed at Sebring, Fla., where Army Air Forces bomber crews rehearse for combat. This article relates how these qualities are fostered among the nine members of each B-17 crew.

The flying missions during this training period are of three general types. On fighter control missions formations of Flying Fortresses learn to concentrate their fire in the face of an attacking enemy. On patrol missions the same formations combine practice with practical duty by searching for submarines over the Gulf of Mexico. On bombing missions nearby ranges are bombed with 100-lb. sand-filled duds with spotting charges. *Air Facts*, August, 1942, pages 33, 36, 66.

The Story of CPTP—Part 2. Robert H. Hinckley. A continuation of a series of articles showing what the Civilian Pilot Training Program has accomplished. The specific phases covered in this installment are the far-reaching results of the program from its educational aspects, its safety record, its contributions toward the technical development of airplanes, and its furtherance of aviation as a business. *The Sportsman Pilot*, July 15, 1942, pages 10–12, 30, 32, 9 illus.

The C.A.A.'s Standardization Center at Houston. The organization and activities of the Standardization Center at Houston, Tex., for the training and refreshing of inspectors and field personnel are recounted. Originally a Civil Aeronautics Administration Center, a changeover was made from C.A.A. standardization procedures to the instruction of Air Forces Ferrying Command trainees after December, 1941. There are two principal sections of the Center: the Flight Branch, which includes an Instrument Flight Section, an Advanced Flight Section, and a Basic Flight Section; and the Technical Branch, which has four laboratories—Aircraft, Procedure and Certificate, Ground and Mechanic School, and Power Plant.

The article also gives an account of the facilities and personnel of the Center. A brief outline of the Air Corps Ferrying Command trainee course is included to provide an example of the Center's concept of a sound approach to keeping up with the industry's needs. *The Sportsman Pilot*, July 15, 1942, pages 16, 17, 32, 33, 3 illus.

Hangar Flying. Leah Shepherd. A plea for the training of more women pilots to become elementary instructors on light planes, thus releasing needed man power for heavier airplanes. Based upon her own experiences as a student, pilot, and instructress, the writer gives reasons why she believes women are well qualified for this job. *The Sportsman Pilot*, July 15, 1942, pages 24, 25, 36, 2 illus.

The Men Behind the Men Who Fly. The organization and functions of the Technical Training Command of the Army Air Forces are described. This branch of the service has been expanded in a short time from a few

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A 14-cylinder Wright Cyclone engine from a twin-engine Boston bomber which had participated in the daylight raid on France. The Boston had its other engine shot away and the engine shown brought the plane back. Note the three shell holes in the nose section and the machine gun damage to the ignition harness and the cylinder head fins. One bullet went completely through the steel barrel of the cylinder and one magneto was shot away.

Army bases to a network of more than 50 stations and schools, into which have been incorporated numerous civilian mechanic schools and post-graduate classes organized by leading aircraft manufacturers. Courses available to enlisted men are outlined and the student's progress is followed to the completion of his training as a skilled specialist in ground maintenance and as a flying crew member. *Western Flying*, July, 1942, pages 36, 41, 2 illus.

Warfare

Bomb Defense. Col. A. M. Prentiss. Steps to be taken in developing a defense against bombing are outlined in this article. It is suggested that the first step to be taken would be to remove essential industrial plants and vital utilities from the cities, dispersing them in rural areas. This necessity is considered as a factor in a decentralization movement under which factories will in the future be located outside of the large cities.

Aerial bombs are broadly classified into two divisions—the high explosive type and the incendiary type. Each of these types is then discussed and their effects are analyzed. Practical methods of protection against bombs are suggested. Consideration is given to toxic gas bombs, which have not been used extensively to date but against which protection should be prepared. Measures for both individual and collective protection from aerial gas attack are suggested.

The writer expresses the opinion that the effects of bombing up to this time are merely a fraction of the ultimate possibilities in air bombardment for the destruction of life and property. He therefore feels that bomb-proofing, fire-proofing and gas-proofing of all important buildings and utilities should be taken care of promptly, the extent of such measures being governed by local conditions. In conclusion it is noted that since science and engineering have succeeded in overcoming the destructive effects of natural calamities, they must now dedicate themselves to similar protective measures against man-made destruction from the air. *Army Ordnance*, July-August, 1942, pages 54–58, 1 illus.

Channel Sweep. Copy of a talk broadcast in the Home Service of the British Broadcasting Company by a Royal Air Force squadron leader. He gives an account of a typical operational flight made by a fighter pilot whose job is to help escort bombers on a raid against German objectives. A step-by-step version, from preparations for the expedition until the return to the home base, is given. The speaker lays emphasis upon the fact that in this type of operation the chief concern of the fighter-pilot is not to bring down enemy planes but to protect the bomber and see that it returns safely. *The Aeroplane*, July 3, 1942, pages 14, 15, 3 illus.

"He Who Holds Alaska—Holds the World." Fred Graham. As a part of a survey of the strategic importance of Alaska, the role to be played by air power is mentioned. The late Gen. William L. Mitchell is quoted as one of the earliest advocates of a strong Alaska as a defense against raids from Asia and as a base for attacks by United States long-range bombers. *Air Trails*, August, 1942, pages 14, 15, 55, 57, 10 illus.

Japs Are Their Specialty. Russ Johnston. This report of the Flying Tigers includes several accounts of individual members of the American Volunteer Group, their exploits, and their attitudes toward their job. The Flying Tigers' fighting technique of meeting the enemy in pairs, as worked out by their leader, Gen. Claire Chennault, is interpreted. Details are also given on the construction of the P-40 fighter used by the A.V.G. in China. Comparing this plane with those used by the Japs, the writer explains how the Tigers concentrated on those of its qualities which yielded them advantages over their enemy. *Flying and Popular Aviation*, August, 1942, pages 22–24, 86, 6 illus.

Air Power and the Coming Invasion. Cy Caldwell. The writer's opinion of what the United Nations' war strategy should be is based on the theory that Germany must be knocked out of the war first. His suggested line of attack is that we must invade the continent now and that unquestioned superiority in the air pave the way for a strong land invasion with sea support. Conjecturing on probable methods and places of attack, he names the French channel ports as

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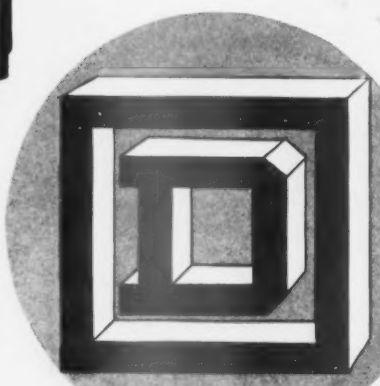

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being the most likely points of penetration.

In addition to air mastery, he lists the following factors controlling the invasion: weather suitable for air operations; English Channel smooth enough for small boats to cross; the shipping situation; sufficient numbers of men and amounts of material on hand; and the situation on the Russian front. *Flying and Popular Aviation*, August, 1942, pages 31, 76, 78, 80, 84, 1 illus.

Fighting the Incendiary. Edward Churchill. Description of a new method of extinguishing magnesium fires. Devised by Vega Aircraft personnel because of the tremendous danger to aircraft plants from incendiary bombs, the extinguishing agent is a combination of several viscous liquids and carbon dioxide. Although harmless to people handling it and to machines, it is said to have the power of instantly putting out magnesium fires. Economy and ease of operation are other advantages claimed for it. *Flying and Popular Aviation*, August, 1942, pages 42–44, 102, 104, 4 illus.

How to Baffle a Bombardier. Merrill De Longe. The work of the camoufleurs attached to the camouflage laboratories at Fort Belvoir, Va., is described. Devices are invented for the purpose of deceiving observers and bombardiers in enemy aircraft and concealing important installations. The endless experiments through which these results are obtained are outlined, as well as the different methods followed. It is said that the oblique angle from which the attacking bombardier views the target furnishes the fundamental principle upon which aerial camouflage operations depend. Blending of colors, distortion of shadows, the suspension of false ceilings of netting over objectives and the placing of dummies to simulate grounded aircraft or other installations are some of the methods employed. New ideas must be developed constantly. Allowance must be made for the probable success of infrared film, stereophotography and other scientific means utilized in baring the tricks of the camoufleurs. *The Saturday Evening Post*, July 11, 1942, pages 18, 19, 9 illus.

Welding

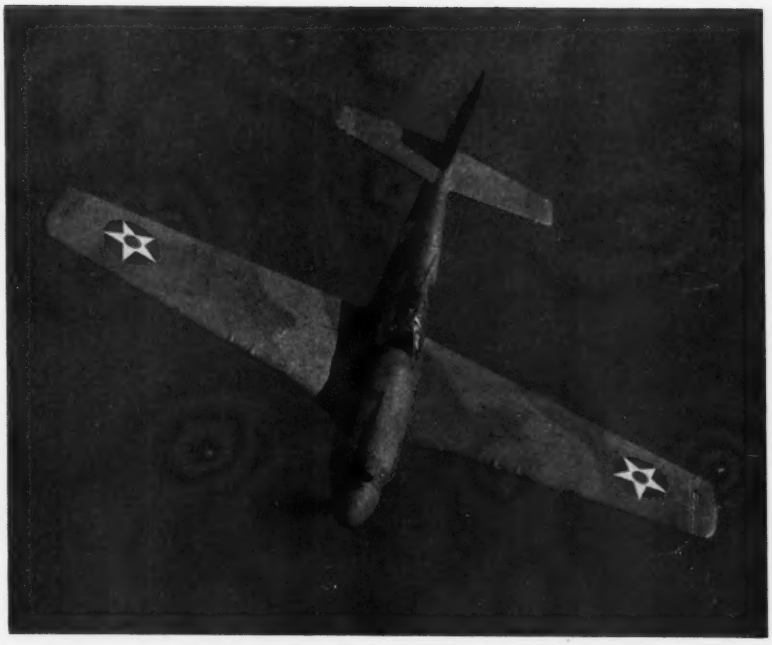
Welding in Aircraft Construction and Maintenance. A. K. Seemann. A system for controlling the welding procedure for aircraft structures is presented, constituting a written specification which takes into account the five major factors that should be considered. These essential elements are: (1) design suitable for welding; (2) selection of materials and their inspection; (3) establishment of proper procedure; (4) welding operators properly qualified; and (5) inspection and testing of finished work.

This article does not attempt to discuss in detail the various principles involved in procedure control, but an effort is made to present information on elements that have been troublesome in both engineering and production. A detailed study is made of the causes of cracks and remedies are suggested to prevent their appearance.

Care is urged in the selection of materials, with a brief discussion of the characteristics of S.A.E. X 4130, and X 4340 steels. The importance of planning the work is stressed so that a definite procedure can be followed. Instructions are given concerning the welding technique to be adopted and the qualifications to be required of the welding operator. Numerous applications of oxyacetylene welding and cutting are suggested for maintenance work on aircraft and in the plants in which they are constructed. *The Welding Journal*, July, 1942, pages 437–442, 12 illus.

Arc Welding of Sheet Metal, Parts II and III. J. V. Thomas. Part II of this article covers butt welds in flat, vertical and overhead positions. Full penetration and optimum strength are the requirements for the flat position, according to the writer. Welds are made without backing and are arc welded from one side only. Arrangements for vertical butt welds for 8-gauge and thinner sheets, as well as overhead butt welds for various thicknesses, are illustrated.

Part III refers to fillet welds in flat, vertical and overhead positions, and lap welds. Positions in which the electrode should be held are sketched for fillet welds for flat work. Suggestions are made for vertical and overhead lap welds, as well as vertical fillet welds. In both parts of this article, procedures, speeds and amounts of electrode per joint are tabulated. *Sheet Metal Industries*, June, 1942, pages 854, 856, 6 illus.; July, 1942, pages 1037, 1038, 3 illus.



A North American P-51 Mustang Fighter.

Technique for the Gas Welding of Rolled Aluminum. This article is an abstract from a report to be issued by the Institute of Welding. It gives consideration to the properties of aluminum affecting welding technique, holding that the most important characteristic of the metal is the layer of oxide always present on the surface. Effects of the composition of the metal are summarized under seven points and the behavior of various alloys is outlined. Information is given on the welding flame. The article is to be continued. *Sheet Metal Industries*, July, 1942, pages 1031–1033.

Wind Tunnels

North American's New Wind Tunnel. A brief description is given of the new wind tunnel at North American Aviation which is capable of producing an air speed of 327 m.p.h. It is expected that this new facilty will add considerable speed to the test work on proposed new models and for improvements on models already in production. *Aero Digest*, August, 1942, page 193, 3 illus.

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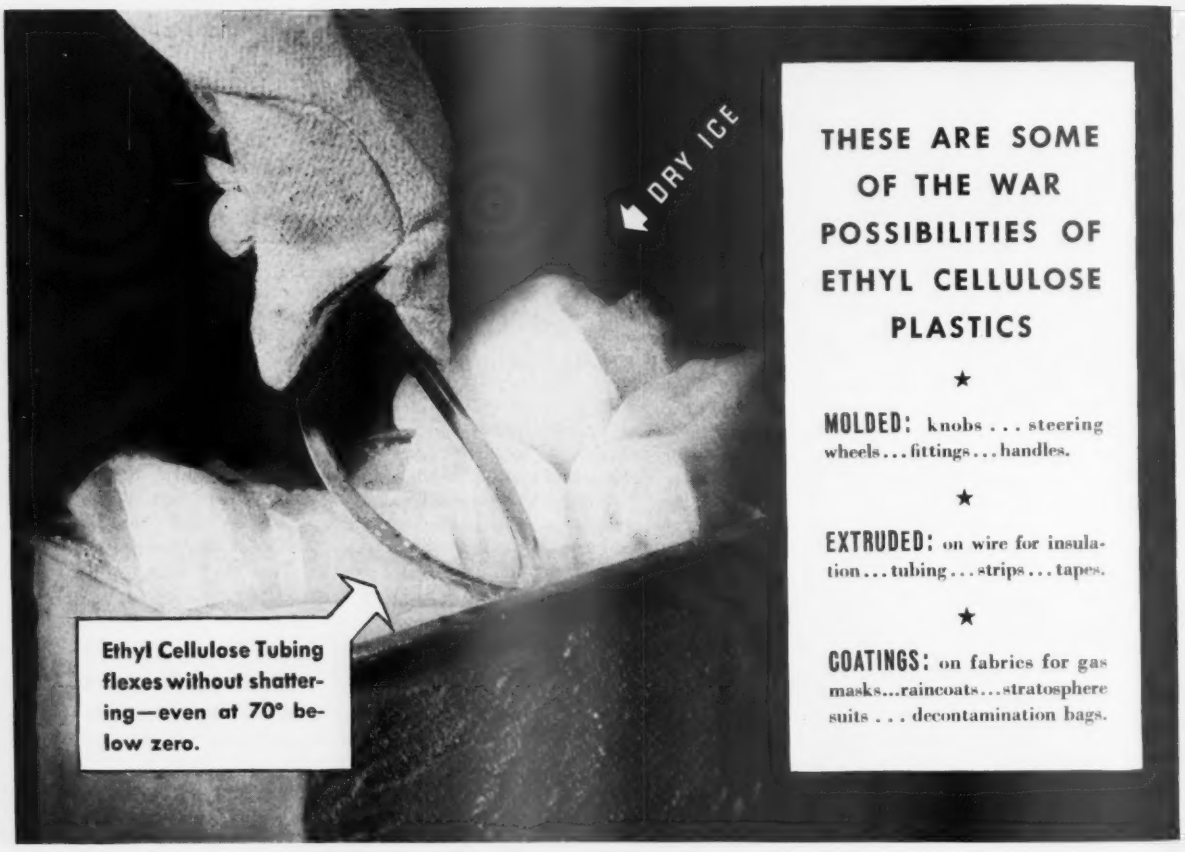

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Government Publications

National Advisory Committee for Aeronautics

Diagramme zur Berechnung von Flügelreihen (Diagrams for Calculation of Airfoil Lattices), translated from *Ingenieur-Archiv.*, Bd. II, Heft 3, Sept., 1931. The field for curved blades is represented by a vortex series with a vortex removed at the blade point. Further, an example of calculation of a curved blade from this series is given, whereby the necessary accuracy required of the different methods in practice is shown according to the case considered. *N.A.C.A. T.M. No. 1022*, July, 1942.

Die ebene Potentialströmung um allgemeine dicke Tragflügelprofile (Two-Dimensional Potential Flow Past an Ordinary Thick Wing Profile), translated from *Jahrbuch 1938 der deutschen Luftfahrtforschung.* This report deals with the development of a method that gives a lucid and convenient solution of the flow conditions in the vicinity of a common, thick airfoil section wherein the thickness of the profile is taken into account. The method consists of making the airfoil the stream line in a parallel flow by disposing on its mean line certain source and vortex distributions, the fields of which are superposed on the parallel flow. These distributions of singularities are secured for the generalized Kármán-Trefftz profile by means of conformal transformation from the flow about a circle. Five different distribution functions are afforded for the density of superposition which combine in a specified manner to the necessary distributions of singularity and represent a generalized Kármán-Trefftz profile in parallel flow. For these profiles the speed for each of the five distributions is then computed independently of the angle of attack.

This substitution of a profile theoretically secured by singularities is then extended to include more general airfoil shapes, since a simple method permits a close approximation of any profile by a generalized Kármán-Trefftz profile with known substitution of singularities. This approximation then affords the solution of the velocity field in the neighborhood of the general thick airfoil by a convenient method. For each of the five functions of the superposition density a speed diagram is plotted; the curves of constant speed parallel to the coordinate axes are combined to an orthogonal system. The readily discernible effects of the individual singularity distributions on the speed at any point of the plane of the section are in a simple manner correlated to the speeds. For comparison, the speeds can be computed by the same method conformally to Birnbaum's approximation. It is found that the omission of the profile thickness is permissible only at great distances—that is, approximately of the order of magnitude of a wing chord.

A method is also given which affords a check on the agreement of the profile contour with the closed stream line defined by the singularity distributions. A further method enables the prediction of the profile contour for any selected singularity distribution.

After completion of this article, *Z.f.a.M.M.*, Vol. 18, 1938, p. 107, carried a report by F. Weinig entitled "The Flow Conditions in the Field of Thin, Slightly Cambered Airfoil Sections," which gives the velocity distributions for thin profiles in accord with the writer's calculations. This writer also considered the effects of complicated camber shapes. But the essential of the present article is the determination of the effect of profile thickness, which was not considered in Weinig's report, although it is very pronounced, according to present study. In general, it should be stronger than the effects of the mean-line forms exceeding Birnbaum's formulas. *N.A.C.A. T.M. No. 1023*, July, 1942.

Civil Aeronautics Administration

Information is quoted from the Safety Bureau of the Civil Aeronautics Board regarding the danger of accidents due to excessively worn parachute harness of the quick-detachable type. In many instances, it is stated, when the parachute is due for inspection, flight operators have detached the parachute from the harness, sending the former to the rigger for inspection and retaining the harness for use with other parachute packs. In such cases the harness receives no inspection. Flight operators are cautioned to check their harness and it is suggested that riggers make every effort to have the complete parachute assembly, including harness as well as parachute, together at the time of repacking. *Civil Aeronautics Journal*, July 15, 1942.

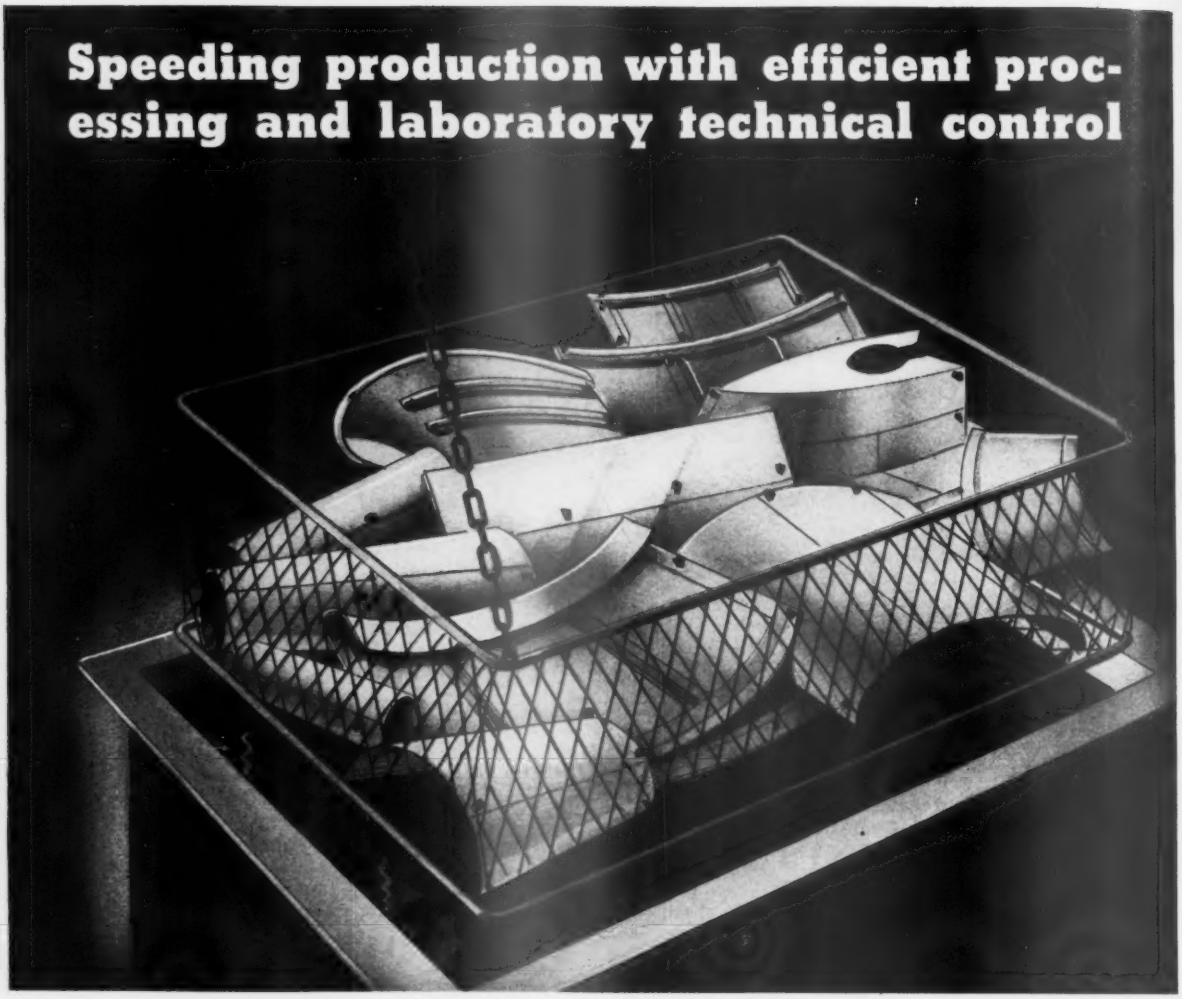
Civil Aeronautics Board

Turnbuckles. W. E. Koneczny. In this article it is stated that even prestretched aircraft cable has a definite tendency to rotate when under load. Tests show that rotation tends to unwind one of the terminals from the turnbuckle barrel. Thread friction and the safety wire are the only factors restraining the terminal from unwinding completely. Large size cables, longer lengths and vibration in the cable, all tend to increase the trouble. In the majority of tests, failure was found to be due to a fractured safety wire. It was concluded that conventionally secured turnbuckles are satisfactory in service only when proper precautions are taken during their installation. Safety wire of the largest possible size is advised. Brass, copper and other soft wire of comparative strength are preferable to steel wire, which is difficult to install. Double-wire wrap offers added insurance. Frequent replacement of safety wire is advised. *Safety Bulletin No. 134.*

U.S. Weather Bureau

New sheets (pages 30-R, 34-R, 35-R, 35a, 35b, 62-2R, 88-R, 89-R) have been published effective August 1, 1942, for insertion in "Instructions for Airway Meteorological Service." These cover sky conditions, visibility and weather observation. The final three pages give instruction on the use of forms for reporting synoptic observations.

Speeding production with efficient processing and laboratory technical control



Information supplied by "Aeronautical Engineering Review" and Northrop Aircraft, Inc.

Vitally important today is the unfailing combination of Quality with Quantity in airplane production, by engineering development, processing and control.

Important time savings are resulting from spot-welding aluminum alloys in place of the thousands of rivets formerly used in aluminum alloy assemblies. However, consistently strong spotwelds demand uniformly clean metal surfaces, plus rigid shop and laboratory control, consisting of shear tests, fatigue tests and microscopic examination.

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Northrop Aircraft, Inc. now joins component parts with Cleco and Skin-tight fasteners in unit assemblies in the original jig before cleaning and etching. The assemblies are then cleaned and etched in one cold tank operation followed by a cold water rinse and air dry. More uniform, consistent spotwelds result throughout entire assemblies.

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Flying Models and Aviation

Directions for building and flying four successful types of flying models are contained in this instruction book for young model builders. Referred to as a "first course in aviation" in the foreword, this book includes information on the elements of aeronautics, such as the theory of flight, wing designs and stability. A glossary of terms is included in the concluding pages.

Airplane Models and Aviation, by Willis C. Brown; D. C. Heath and Company, Boston, 1942; 43 pages, $0.48.

Aerial Adventures

This is an autobiography of Beryl Markham whose life in Africa led to a career of considerable distinction as a pioneer in aviation on that continent. Her childhood days are told and her entrance into aviation, which she followed as a career. Her adventures as an aerial scout for elephant hunts and her numerous flights to such places as Cairo, Salum, Benghazi, and Tobruk are related. The book concludes with the details of her flight from England to North America. In this she is credited with having been the first woman to fly the Atlantic westward, although the flight was not quite completed to New York, having ended in a swamp on Cape Breton Island.

West with the Night, by Beryl Markham; Houghton Mifflin Company, Boston, 1942; 293 pages, $3.00.

Aeronautical Dictionary

In this second edition of the Aviation Dictionary and Reference Guide, the material has been completely revised and brought up to date in definitions, text and illustrations. It has been rearranged into major divisions including the dictionary of terms and abbreviations, directory information and reference sections on flying, aircraft design and production. More than 1,000 new terms have been added to the 3,500 definitions in the first edition, as well as numerous new illustrations, charts and tables and completely new text material in many fields.

Supplementing the definitions and illustrated nomenclature, sections on civil flight regulations, meteorology, radio-range orientation and various mathematical tables are included. Other sections present information on a wide range of topics relating to aircraft design and shop mechanics. A guide to studies for airmen is divided into parts covering basic general studies and requirement studies for pilots, and subjects needed for certificates of aircraft mechanics and engine mechanics.

Another section includes directory information on aircraft manufacturers, engine manufacturers, air lines, repair stations, schools, aeronautical organizations, United States Government aeronautical agencies, government publications and private publications dealing with aeronautical subjects.

Aviation Dictionary and Reference Guide, by Harold E. Baughman; Aero Publishers, Inc., Glendale, Calif., 1942; 906 pages, $6.50.

Books reviewed in this section may be purchased, or borrowed without charge, from The Paul Kollsman Library, Institute of the Aeronautical Sciences, 1505 RCA Building West, Rockefeller Center, New York, N. Y.

Aircraft Hydraulic Principles

Mimeographed in loose-leaf form and bound in a paper cover, this book is a study of hydraulics as applied to aircraft equipment. It explains the operation of hydraulic equipment in such a way that the mechanic may understand the working of the basic units and systems and be able to apply this knowledge to maintenance and repair duties.

Illustrations have been simplified for clarity, certain lines and parts having been omitted in some cases to facilitate a study of the various parts and units. All illustrations are schematic and intended to show the operation; they do not attempt to be finished engineering drawings.

Basic hydraulic principles are explained, followed by a study of the individual parts and of the actuating units which constitute the complete system. Control mechanisms are covered. The final pages outline several complete hydraulic systems and their functions. A set of 40 questions and answers serve to review the text matter.

Airplane Hydraulic Systems, by Hugh C. Aument, Jr.; published by the author, Mineola, L.I., N.Y., 1942; 59 pages, $1.50.

Aircraft Structural Design

About 40 per cent of the text of this book is a revision of *Structural Design of Metal Airplanes* published in 1935. It was found necessary because of the great progress and expansion in airplane construction to limit the text strictly to the mechanical aspects of the structure, keeping at a minimum the treatment of the broad field of design.

Some idea of the scope of the present volume is given by the chapter heads as follows: (1) design requirements; (2) materials of fabrication; (3) summary of basic stress formulas; (4) structures, past, present, future; (5) properties of structural sections; (6) fundamentals of structural analyses; (7) beams, columns, and beam columns; (8) continuous beams and continuous beam columns; (9) analysis of torsion members; (10) elementary principles of design of sheet metal construction; (11) design of flat reinforced plate structures; (12) design of curved reinforced plate structures; (13) design of thin-walled columns and stringers; (14) torsional rigidity of wing box beams; (15) introduction to cantilever-wing analysis; (16) design of thin-sheet wing webs; (17) introduction to shear lag; (18) problems in fuselage design; (19) pressure-cabin structural design; (20) wing flutter and other structural vibrations; (21) riveting in aircraft construction.

The theme of this book is faith in the capacity of the younger generation to achieve progress in science and improvement in engineering and production through its critical point of view toward present methods and its constant search for something better. This applies particularly to the young engineers now in school and just beginning their careers, who are counted on to discover new combinations of materials and new methods of fabrication surpassing anything now known.

Mechanics of Aircraft Structures, Second Edition, by John E. Younger; McGraw-Hill Book Company, Inc., New York, 1942; 395 pages, $4.00.

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INDUSTRIAL FINISHES

Basic Information on Plastics

Written for the actual users of plastics who require basic information on these materials in a compact volume, this book attempts to obviate the necessity for spending considerable time in a detailed study of the chemical principles involved or the complex problems of those who manufacture the materials. It has been prepared as a textbook for schools to prepare students to meet industrial problems and as a reference handbook for designers desiring to increase their knowledge of modern plastic materials.

Basic knowledge is given concerning the history, origin and recent material sources of plastics, their chemical, physical and electrical properties, and their limitations. Methods of fabrication and information concerning plastic design are also dealt with. The purpose of the book is to enable the designer to plan the construction of his products in the form of simple assemblies, stampings, die castings and screw machine parts, giving him enough information to take advantage of the important properties of plastic material.

As a reference book, this handbook is for consultation in the designing of a new product or when manufacturing problems necessitate changes in product design. Chapter XIII contains information and charts to facilitate the selection of materials and Chapter XIV contains details of mechanical and electrical design which should be observed in order to achieve low cost and a minimum of manufacturing problems.

Plastics, by J. H. DuBois; American Technical Society, Chicago, 1942; 295 pages, $3.00.

Directory of Societies

The fourth edition of this handbook contains data on 1,412 organizations, societies and associations that contribute to the advancement of knowledge of the natural sciences and related fields. It covers the United States and its dependencies and the Dominion of Canada, including 1,269 institutions of United States nationality and 143 in Canada. In addition to organizations devoted to the natural sciences and technology, several of the more general societies and special institutions supporting scientific research have been included, as well as certain trade associations that are active in research. Although no attempt has been made to list scholarly organizations in fields outside of the natural sciences and technology, the appendix contains references to organizations that will direct readers to sources of information about societies not included in this book. United States Government agencies, organizations directly controlled by universities, foundations that contribute financially to research in the form of grants rather than conducting research directly, and industrial research laboratories are, in general, not included.

Information is presented in the form of name and address of each organization, its principal officers, history, objects, membership classes, meetings, funds, libraries and publications, the latter including only regular serial publications.

Separate indexes for the United States and Canadian sections offer classifications by subjects of the activities, purposes and research funds of the organizations, and the current edition includes a personnel index of the officers of the various societies.

Handbook of Scientific and Technical Societies and Institutions of the United States and Canada; National Research Council, National Academy of Sciences, Washington, D.C., 1942; 389 pages, $4.00.

Elementary Mathematics for Airmen

Offering no pretensions as a textbook of mathematics, this small volume was prepared with the primary objective of supplying a progressive course in mathematics for cadets in training courses. The general plan follows the procedure as laid down in the British Air Training Corps Syllabus of Training. It has been the aim of the authors to afford a rapid revision of elementary processes and to show the application of those processes to the numerous problems and interests of the services.

An attempt has been made to introduce instructive interests in the special branches of the services, by means of a wide selection of problems so that cadets may see the value of training in elementary mathematics through its practical application. Another purpose of the authors has been to overcome in part the difficulties encountered in group instruction because of the variation in educational attainments of the students, as found in the Royal Air Force. To provide scope for individual progress through self-instruction, with consequent gain in self-reliance, is another important result sought.

The book starts with a study of elementary arithmetic, progressing into some of the more advanced branches, and follows a similar course with reference to elementary algebra. Instruction is given in the use of graphs. Geometry, logarithms and trigonometry are then considered.

Aircraft Mathematics, by S. A. Walling and J. C. Hill; The Macmillan Company, New York, 1942; 189 pages, $1.25.

Inspection of Ferrous Metals

The second edition of this book was necessitated by the rapid growth in the use of the Magnaflux inspection method which has expanded at an unusual rate, particularly in connection with aircraft and aircraft materials. Another factor has been the development of production-type inspection units, suitable for rapid and specialized use on the assembly line, whereas heretofore the process was largely confined to laboratory work with machines intended to perform many different inspection operations.

While the present volume does not contain any sweeping revisions, it has been enlarged in various ways, including the addition of photographs of Magnaflux patterns, and new material has been added, in particular a chapter on Detectable Defects.

The opening chapter discusses elementary theories of magnetism, induction and polarity, upon which this method of inspection is based. Different methods of magnetizing and the numerous kinds of magnetic fields are described, and comments are made on the possibilities and the limitations of the various methods. The discussion then turns to the characteristics of various magnetizing currents, the sources of current supply and types of magnetizing equipment. The inspection medium is classified under the headings of the dust or dry-powder method and the wet method technique under which magnetic particles are applied while suspended in a liquid.

The two kinds of defects are classified as detectable and nondetectable, and each of the numerous characteristics of these defects is set forth in considerable detail.

Other chapters are devoted to false indications and the ways by which confusion of these with true indications can be avoided. Since the inspection of welds forms an extensive field for the use of the Magnaflux method, that subject is treated individually, with explanations of the fundamental methods, techniques and equipment used in the class of work.

The subject of deterioration is regarded as an important branch of Magnaflux inspection work, the limits being defined and methods of accomplishing it being considered. The various ways of restoring specimens after magnetization are classified and apparatus is described. The final chapter deals with the interpretation of the indications derived through these inspection methods.

The bibliography has been enlarged by the addition of material either published or brought to the author's attention subsequent to the compilation of the first edition and references are made to the bibliography in the present vol-

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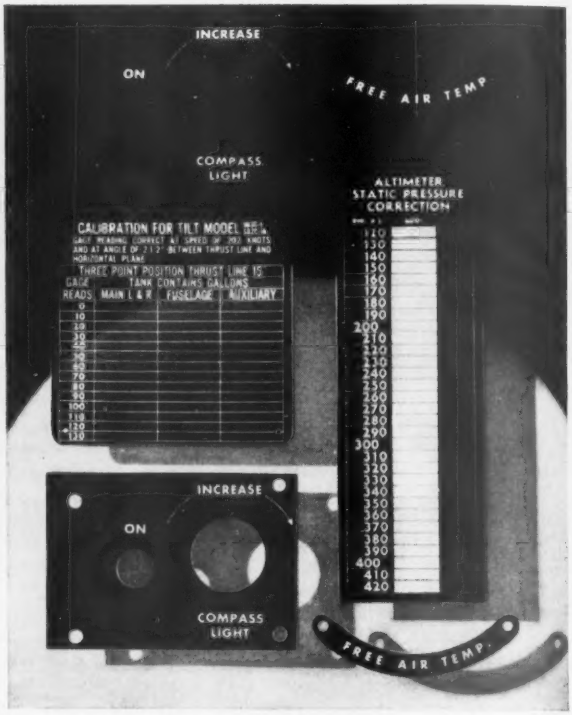

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ume, whereas this was not done in the first edition.

Principles of Magnaflux Inspection, by F. B. Doane; Magnaflux Corporation, Chicago, 1942; 288 pages, $2.50.

Manual on Camouflage

Compiled from the experiments and experiences developed in the classrooms and camouflage laboratory at Pratt Institute since the program was started in September, 1940, this book has been expanded in scope from its original use as a student manual to embrace the entire field of industrial camouflage. It is primarily a report of the activities at the Institute in this new phase of the defense effort, offered as a contribution to the subject which is of growing importance at present. For economy, it has been produced from typewritten copy, on single-faced pages, bound in loose-leaf style.

The book is divided into four parts: the first covers the aspects, requirements and problems of visibility, the principles of bombardment, the analysis of industrial areas, problems of decentralization and new designs for industrial buildings. Part II sets forth the principles, methods and materials used for air-raid protection, including the study of shadows, textures and patterns in nature, optical problems, and landscaping.

Part III contains studies of examples of camouflage practice and methods of obscuring buildings by means of deceptive coverings. Designs are suggested for the protection of storage tanks, grain elevators, water towers and other structures difficult to conceal, and examples of actual installations are given. Part IV contains a typical plan for camouflaging a factory.

Industrial Camouflage Manual, by Konrad F. Wittmann; Reinhold Publishing Corporation, New York, 1942; 128 pages, $4.00.

Parachute Manual

This manual was prepared for the purpose of presenting a brief, nontechnical description of the different types of parachutes, methods of operation, their use, servicing, packing and general care. Divided into twelve chapters, the book begins with a brief history of parachutes, crediting the first suggestion of the parachute to Leonardo da Vinci, and reviewing early developments up to the first World War. Nomenclature is given in the second chapter, and types of parachutes, materials and requirements are discussed in the next two chapters.

Recent developments and improvements, military and civil regulations concerning the use of parachutes, and procedures in using, maneuvering and landing them are discussed in chapters five through eight. Some famous parachute jumps and numerous incidents in connection with parachutes are recounted in the ninth chapter. The remainder of the book refers to the military uses of parachutes, training troops, use, maintenance, care, inspection and packing of parachutes.

Parachutes . . . . Development . . . . Use . . . . Maintenance, by J. Floyd Smith; published by J. Floyd Smith, Manchester, Conn., 1942; 91 pages, $1.00.

Petroleum Refining Processes

This revised edition of *Chemical Refining of Petroleum* includes the investigations and processes developed since the publication of the first edition 7 years ago. The whole book has been revised and much of it has been entirely rewritten.

The purpose of the volume is to present the theory and practice of the different chemical processes used in the refining of petroleum and its products, and in improving certain characteristics of the finished products. The one volume attempts to offer the data and results of investigations in chemical refining and the use of various reagents in the improvement of petroleum products, collected from numerous sources, so that the information on this subject may be readily available. Discussion is presented of those investigations and processes that the authors have found to be of practical importance through their own experience in petroleum technology. Also included are brief comments on numerous proposed processes of somewhat questionable value for the purpose of presenting a complete record of the subject.

Because petroleum samples differ so widely in their composition and because of the complexity of the constituents of any particular grade of crude petroleum, as well as the changes continually taking place in the properties sought in the finished products, refining processes rapidly become obsolete or the processes found suitable for one oil may prove to be inadequate for another. These factors must be kept constantly in mind by investigators in the application of any chemical to petroleum.

The first chapter deals with the composition of petroleum and its various major products. Succeeding chapters deal with methods of treating crude petroleum with sulphuric acid, hydrogen sulphide, alkaline reagents and the so-called sweetening operations. Refining by adsorption and refining with solvents are the subjects of the next two chapters, while detonation and antidetonants and inhibitors of atmospheric oxidation are treated in two following chapters. Gums and cracked petroleum products are treated in Chapter 10 and deterioration of lubricating oils, with corrective processes, are detailed in the final chapter.

A supplementary list of United States patents on petroleum refining has been added, the patent literature of the first edition having proved valuable. Special tables appear in the appendix for conversion of temperature values and chemical equivalents. Patents, authors and subjects are indexed separately.

Chemical Refining of Petroleum, by Vladimir A. Kalichevsky and Bert Allen Stagner; Reinhold Publishing Corporation, New York, 1942; 550 page, $7.50.

Riveting Instruction

Based on the practical experience of the author in riveting and also in training student riveters, this course of instruction treats riveting as a phase of metal construction. Riveters are not regarded merely as construction mechanics but as skilled workers employing a variety of techniques. The various skills and practices used in aircraft metal construction are treated in a separate and distinct form so that any of them can be applied in metal aircraft or subassembly work.

The methods employed in aircraft riveting construction and repair have been completely divorced from metal construction. These chapters have been prepared simply as a treatise on riveting fundamentals, basic skills and practices used in aircraft construction or repair, without reference to the completed airplane or its parts. It has been the purpose of the author to provide training broad enough to prepare students for any type of riveting operation prevailing in any shop or locality, keeping in mind the fact that these methods differ in various plants and locations.

The text is presented in a sequence found by the author to have been most helpful to the students. The first two chapters cover identification of rivets and equipment, while various safety precautions are set forth in the third chapter. Next in order come the techniques of drilling rivet holes and the preparation of materials, and specifications and nomenclature covering aircraft rivets in common use. Testing and checking methods, removal of rivets, use of bucking bars and care of pneumatic equipment and accessories are treated in succeeding chapters. Special riveting procedures are approached through a discussion of upsetting solid and semitubular rivets and reverse bucking and flush riveting. The final chapter describes automatic and multiple-setting machines and the appendix

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Milk, butter, eggs, fish, meat, cheese, beans and peas, fruit, green leafy vegetables and the yellow ones, whole-grain or enriched cereals and bread—these are the *key* foods. Eat plenty of them. *And* eat 3 meals a day!

2. Get Your Rest

Regularity counts most. You can't catch up on *lost* sleep or *missed* relaxation! Try to keep on a regular schedule every day. Take it easy for a little while after lunch and dinner. Go to bed on time, get up on time.

3. See Your Doctor Once a Year

You have your *car* checked and serviced every thousand miles. Do as much for your body. Physicians can *prevent* many diseases and illnesses for both children and grownups nowadays. Give your doctor a chance *now*, BEFORE you get sick. Go to see *him!*

4. Keep Clean

Plenty of baths, lots of soap. Clean hands, clothes, houses, beds! Get fresh air, sunshine. Drink lots of water.

5. "Play" Some Each Day

Romp with the family, visit with friends, take walks, play games—or do whatever you like to give your mind and body a change from the daily grind on the job. "All work and no play makes Jack a dull boy."

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contains riveting terminology, miscellaneous tables, weights and other data.

A detailed discussion of the plan followed by the author in his teaching work at the Burgard Vocational High School at Buffalo, N. Y., is appended as "Suggestions for Teachers."

Aircraft Riveting, by Albert H. Nisita; McGraw-Hill Book Company, Inc., New York, 1942; 160 pages, $2.50.

Processes in Manufacturing

Written primarily for engineering students and including the fundamentals of manufacturing practices, engineering materials and equipment, this book not only supplements the usual shop laboratory practice but is intended as a textbook for courses without laboratory work. The usual branches of shop work are included in this book, approximately one-half of which is devoted to such subjects as foundry practice, patternmaking, metal casting, plastic molding, heat-treating and welding. The second half of the book is devoted to machinery, accessories, cutting tools and measuring instruments. The author has confined the information to fundamentals, describing the machine or process and discussing its application and limitations.

A set of typical projects is provided at the end of the book for the benefit of the instructor in laboratory work. These projects are designed to provide actual experience for the student with the major types of production equipment. Detailed information has not been attempted concerning the setup and operation of machinery since these phases are considered by the author as more suitable for teaching by lecture and demonstration.

Each chapter is planned to cover its individual subject, starting with foundry practice and proceeding with other methods of treating raw materials. Measuring instruments and gauges and inspection work are included in one chapter and then individual machines are studied. Numerous tables are included to facilitate reference work. The illustrations include photographs of various machines and manufacturing processes, as well as photomicrographs showing the construction of metals and drawings of numerous types of industrial equipment.

Manufacturing Processes, by Myron L. Begeman; John Wiley & Sons, Inc., New York, 1942; 579, pages $4.50.

Aircraft Encyclopedia

This is the third wartime edition of a book that is regarded as the industry's encyclopedia. It has been revised to conform with data up to the end of 1941. Presented is a comprehensive compendium of the military and naval air forces, civil aviation, airplanes and airplane engines of all the nations of the world. The historical section traces the administration, organization, training and equipment of the air services of each country, together with the addresses of their various departments and commands.

The section containing a review of the military air forces of the world has been completely rewritten and revised to present a picture which is claimed to be more accurate and complete than anything which has been included heretofore, although information concerning the nations at war is naturally influenced by censorship and considerations of security, applying equally to the United Nations and the enemy. Extensive material appears on the air forces of Germany and Japan. Little that is new has been added to the section on Italian war aircraft, and the French section, which was formerly one of the largest in the book, has now been reduced to a single page.

Among the data published for the first time in this edition is some of the history of the formation on British soil of the various Free and Allied air forces now cooperating with the Royal Air Force. A new feature also is found in the diagrammatic representations of the national markings of the world's air forces and over 100 three-view drawings of important aircraft in use or in production in 1941.

Censorship permits the publication of only brief details on the organization of the Royal Air Force and the air services of the Dominions, but a review of their accomplishments in the second year of the war and to the end of 1941 is presented as a picture of the British Empire's air activities.

The performance of Russian aircraft in the war has been a revelation of the ability of a state-controlled industry to design and produce efficient aircraft. Although its operations are cloaked in secrecy, such information as is available has been included and descriptions appear of numerous fighters, ground-attack planes, bombers, reconnaissance craft and flying boats.

The section on civil aviation has been revised and rewritten completely. From new sources, information has been gathered on countries where civil aviation is still active, particularly North, Central and South America. The material published is probably as complete and up to date as may be found in any one volume. For the rest of the world, the data have been brought up to the end of 1941 or to the time of invasion or occupation in the case of territories which became involved in the war during that year.

Despite a small reduction in total number of pages in the book as compared with the previous edition, the number of illustrations in the section on airplanes has been expanded from 429 to 444, and the percentage of new illustrations has risen from 60 per cent to more than 72, the highest ever recorded for this section.

Jane's All the World's Aircraft 1941, compiled and edited by Leonard Bridgman; The Macmillan Company, New York, and Sampson, Low, Marston and Company, Ltd., London, 1942; 449 pages, $19.00.

Structural Design Textbook

One of the GALCIT series of aeronautical texts, this book presents material for the design of aircraft structural components. It does not attempt to establish hard and fast rules for this but supplements recognized design criteria with experimental evidence as to their exactness. Confining the treatment of standard structural problems to a minimum, a large part of this work is made up of controversial material.

The first part of the book covers preliminary considerations in design. In addition to airplane layout, it takes up the problems of determining just what loads are to be expected on the structure

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and how the loads are to be distributed. It also gives the military and civil rules and regulations for commercial aircraft with regard to various loading conditions governing each particular type of airplane.

Part II concerns design methods for structural components subjected to any given combination of loads. Well-known methods of beam and truss analysis are outlined and the basic equations given. Although a great deal of empirical data are included, these are accompanied by such experimental data as are available so that the designer may judge for himself the methods' probable limits of accuracy.

Part III is a short discussion of analysis methods of various structural types used for the major structural items of modern metal aircraft. The advantages and disadvantages of each method are noted.

Airplane Structural Analysis and Design, by Ernest E. Sechler and Louis G. Dunn; John Wiley & Sons, Inc., New York, 1942; 412 pages, $4.00.

Book Notes

Thunder Birds, by Orson Falk; Random House, New York, 1942; 264 pages, $2.00.

A book that has since been issued in motion-picture form, this is the romantic story of an English flying cadet learning to fly in the United States. However, the activities of students from all the United Nations at privately owned, Government-controlled United States flying schools—of which Thunderbird is one—provide the background for this story and are described in some detail.

The Body in the Barrage Balloon, by Colin Curzon; The Macmillan Company, New York, 1942; 213 pages, $2.00.

A humorous mystery novel written by an R.A.F. officer. The book has no connection with the war except its use as background.

North Atlantic Patrol, by Lt.Comdr. Griffith Baily Coale; Farrar & Rinehart, Inc., New York, 1942; 48 pages, $2.00.

This log of a Lieutenant-Commander's experiences on the north Atlantic shortly before the United States' entry into the war is told by him in words and pictures. The author, a mural painter by profession, is able to interpret vividly the duties and adventures of a Navy destroyer around Iceland and Labrador by a series of pictures. His is a day-by-day account of what it is like to patrol icy waters and escort convoys safely to port under black-out conditions. The development of bases and shore installations is also recorded.

Cugle's Practical Navigation, by Charles H. Cugle; E. P. Dutton & Company, Inc., New York, 1942; 565 pages, $7.00.

Consolidating the author's previous works, *Simple Rules and Problems in Navigation* and *Practical Advanced Navigation*, this is a revised textbook on the rules and everyday problems of navigation.

In its practical application of various problems, they are worked out in full and theory is eliminated. A new chapter, called "Deck Officer's Information," has been added.

By Pan American Highway Through South America by Herbert C. Lanks; D. Appleton-Century Co., New York, 1942; 203 pages, $5.00.

Reported to be the first sustained automobile tour from the Caribbean to the Straits of Magellan, a six-month motor trip through South America is related in detail. The capitals of every South American republic, with the exception of Paraguay, were visited and detours took the travelers through thousands of miles of lesser-known territory. The scenery, the people, the industries, the cultures, the changing economic conditions are all commented upon. Photographs illustrate the narrative.

Over and Above Our Pacific by Charles McKew Parr; Whole World and Co., Inc., New York, 1942; 274 pages, $2.00.

A series of letters, written during an airplane trip from New York to Hongkong, records a businessman's impressions of the Pacific area one year before America entered the war. The description of the flight is interwoven with commentaries on the political trends at that time. Visits to Hawaii, Midway, Wake Island, Guam, the Phillipines, and Hongkong lead to analyses that help to clarify events that transpired later.

The Fight for the Pacific by Mark J. Gayn; William Morrow & Company, New York, 1942; 368 pages, $3.50.

By interpreting the pattern of Japan's policy of conquest, this book is offered as an indication of her course in the years to come. The basis of Japan's policy, the strength of her war machine and the weakness of the Allied positions are shown. Reasons are given for the quick fall of Hongkong and Thailand's prompt submission to the invader. This collection of information on the Far East shows Japan as a formidable enemy but one that can be conquered.

Russia's Fighting Forces by Sergei N. Kournakoff; Duell, Sloan & Pierce, Inc., New York, 1942; 258 pages, $2.50.

This is a detailed survey of the materials, money, men, mobilization, and morale of the Soviet army. Preceded by a historical résumé, it reports on Russia's war doctrines and equipment, including the tank and air arms of her fighting forces. An account of Soviet strategy and leadership is given and, in a commentary on new tactics used by the Russian Army, the modern use of cavalry in conjunction with mechanized units is discussed. Included also are factual accounts of battles in the Far East in 1938 and 1939, the war in Finland, and a log of the war in Russia.

The Eagles Roar! by Byron Kennerly; Harper & Brothers, New York, 1942; 271 pages, $3.00.

The story of the Eagle Squadron, famous group of American pilots with the R.A.F., is told by one of its original flyers. An account of who these men were, how they were trained, how they fought, and how many of them died is given in a series of dramatic incidents. Imparting an idea of how the R.A.F. operates, this book tells of raids across the Channel on German industrial cities and German-held invasion ports of France, night fights against German bombers over London, and the night when Coventry was bombed by the Germans.

Strategy for Victory, by Hanson W. Baldwin; W. W. Norton and Company, New York, 1942; 172 pages, $1.75.

The New York Times' editor on Military and Naval Affairs suggests a blueprint for victory. His main thesis is that, contrary to the opinions of sponsors of any one factor of military strength, the war can only be won by a total mobilization of all forces—sea power, air power, land power, and effort on the Home Front in economic and revolutionary warfare. The other point forcefully campaigned for in this book is that victory can only be gained by taking the offensive. The strategy of how to do this is carefully analyzed, and suggestions are made on methods to be adopted and procedures to be followed.

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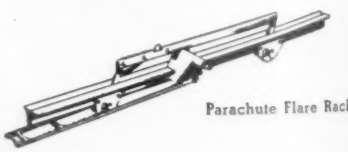

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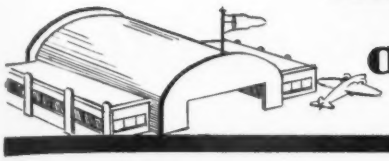

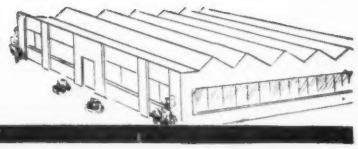

Ack-Ack Gun Production

Anti-Aircraft Guns Effective at Seven-Mile Height. Antiaircraft guns with a range in excess of 30,000 ft. which are being produced in the Fisher Body plants are described. Adaptation of several important automotive techniques is credited with making possible production ahead of schedule. The weapons are being built on a progressive assembly system and the project is divided among several plants. Special tools have been designed and assigned to the job. A training program had to be instituted at all plants to instruct men in operations with which they were unfamiliar. Few details of the gun have been made public. *GM Folks*, August.

Aircraft Gun Controls

G. E. Products Control Airplane Guns. Military demands have required a greatly increased production of armament controls for aircraft. Controls of this type are highly complex in nature and involve special problems both in design and manufacture. It has been necessary for the General Electric Company greatly to increase production facilities in order to supply the demand for these controls. Photographs of the company's craftsmen at work on these controls accompany the article. *The G. E. Monogram*, July-August.

Aircraft in Action

Coral Sea Victory. Stanley Johnston. A foreign war correspondent's description of the performance and exploits of Douglas TBD and SBD airplanes in the Coral Sea battles. In these battles the SBD's and TBD's were said to constitute the entire offensive air striking armament of the United States forces—that is, these were the aircraft that dropped the bombs and torpedoed airplane carriers and other ships. There were fighter planes, of course, but these are classed as defensive craft. Stories of how these Douglas models performed in action as told by returning pilots comprise a considerable part of the article. *Douglas Airview*, June.

Aircraft Instrument Catalogue

An extensive line of aircraft instruments is described in an 8-page leaflet that contains illustrations and specifications of air-speed indicators, rate of climb indicators, compasses, clocks, ice-warning indicators, fuel level and temperature gauges, altimeters, bank indicators and accessories.

An Aeromarine Service Manual gives instructions for disassembling, inspecting and checking compasses, altimeters, air-speed indicators and tachometers. A spare parts price list is included. *Aeromarine Instrument Company*, New York.

Aircraft Instruments

A new catalogue, describing and illustrating the extensive line of Pioneer instruments has been issued. It includes various tables of specifications for the standard instruments supplied for and used on commercial, military, naval and private aircraft. A smaller catalogue presents a selection of pages similar to those in the larger volume. *Pioneer Instrument Division of Bendix Aviation Corporation.*

Aircraft Radio Equipment

Data sheets and leaflets have been issued containing instructions, illustrations, diagrams and specifications for aircraft radio instruments for a variety of purposes. Some of these are in loose-leaf form for inclusion in a binder. Among the instruments covered are aircraft receivers, aircraft transmitters, aircraft radio compasses, crystal units, aircraft microphones, antenna systems, power units, range filters, and numerous other instruments. Aviation Radio Section, *R.C.A. Manufacturing Company, Inc.*

Aircraft Products Handbook

Pesco hydraulic, fuel and air pumps and accessories are presented in a new catalogue and handbook of aircraft production. It contains basic information including variations in port sizes, mountings, performance curves, model recommendations, parts lists, and quarter-size drawings for vellum tracing. It is in loose-leaf form to provide for revisions and additions and is provided with divisions distinguished by the customary color codes. *Pump Engineering Service Corporation*, Cleveland.

Alloys Booklet

"How Aircraft Designing Engineers Use Ampco Metal" is the title of a new booklet which tells of a few applications of Ampco Metal and other bronze alloys for those parts where friction, impact and fatigue are of importance. Among the aircraft components illustrated are propeller assemblies, landing gear, windshield wipers with nonmagnetic parts, and bronze parts for seaplanes where corrosion must be resisted. *Ampco Metal, Inc.*, Milwaukee.

Aluminum Spraying

"Recapping" Puts New Life in Processing Equipment, Too. How the life of machinery and equipment is being extended by the process of metallizing with aluminum is indicated in this brief article. It describes the spray gun, developed and built by Metallizing Engineering Corporation and briefly describes the method by which the work is performed. *Aluminum News-Letter*, July.

Catalogue Insert Sheets

New pages are offered for Catalogue No. 42 of Shakeproof, Inc., which may be easily inserted by placing the sheet in position and pressing the teeth with a pencil. The inserts bring up to date the descriptions of the company's line of locking and plain terminals. Price list No. 1 has also been issued recently on Shakeproof stamped products. *Shakeproof Inc.*, Chicago.

Chemical Warfare

Poison in the Air. Describing the use of poison gas in chemical air warfare and the means to be taken by civilians in escaping gas laid by aerial bombs. How the course of the bombing plane and the direction of the wind affect the dissemination of gas is explained with illustrations. *Shell Progress*, July.

Cold-Setting Resin Adhesive

A 4-page leaflet has been prepared by The Resinous Products & Chemical Company on Uformite CB-551 cold-setting resin adhesive, which replaces Uformite CB-550 and will be supplied on future orders calling for that grade. It contains a description of the new product, the method of mixing, preparation of surfaces, spreading, pressing or clamping, time and temperature requirements, and specification tests.

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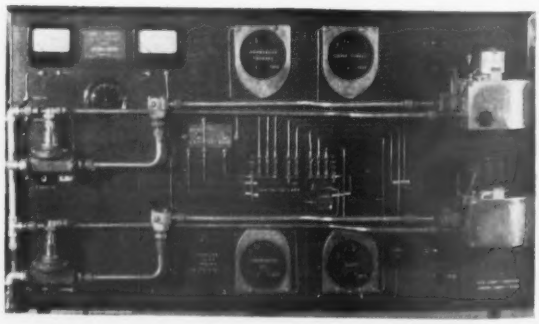
Above is a view of the special service-training school for Air Forces personnel, civilian army instructors and our own service men—both new personnel and old-timers in for refresher courses in latest mechanical developments. Graduates of this course will augment the service personnel already in the field—helping, watching, training. To the end that wherever South Wind Heater-equipped planes fly, Stewart-Warner men, or men trained by them in the "how and why" of the South Wind, can assure our pilots and air crews of the advantages this equipment offers to the fullest degree.



Training involves use of such operating test-panels as this, duplicating actual plane installations. These panels are also sent into the field for training purposes at key points.

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complies with the requirements of new Army-Navy Specification AN-G-8 for cold-setting resin glue and Army Air Forces Process Specification 14114 which calls for the use of a colored adhesive to insure uniform spreading. Uformite CB-551, like Uformite CB-550, is supplied as a dry, water-dispersible powder. Because an inert green dye is incorporated, identity, mixing and spreading are facilitated. *The Resinous Products and Chemical Company*, Philadelphia.

Cutting Tools

Line illustrations showing the various features of the Campbell Model No. 425 Cutalator abrasive cutting machine are used in a new booklet to show its operations and the different shapes and types of materials which the machine will cut. The text matter describes how the machine operates and photographs illustrate its different parts. *Andrew C. Campbell Division, American Chain and Cable Company, Inc.*, Bridgeport, Conn.

Electricity in Aircraft

Electricity Is Vital to Modern Planes. The functions of electrical equipment for military aircraft are outlined. Photographs show General Electric employees finishing magneto coils, inspecting airplane instruments, and testing airplane generators and flying suits. *The G. E. Monogram*, July-August.

Electrical Test Panels

Bulletin No. 115 provides descriptions and specifications of electrical test panels, precision timers and chronotachometers. Jacks and plugs are described in detail, sectional drawings with dimensions being furnished. *The Standard Electric Time Company*, Springfield, Mass.

Fighter Exploits

"Airacobra Ace." A brief article narrating the feats of Lt. Paul G. Brown in engagements with Japanese airplanes in the New Guinea war theater, and the performance of the P-39 Bell Airacobra he flew. In one fight the leading edge of his plane's left wing smashed the tail of a Zero fighter. The Japanese fighter crashed, but the wing of the P-39 was only dented, it is stated. *The Bellringer*, August.

Flexible Hose Catalogue

Bulletin A 48 covers products offered for the aircraft industry. It includes aeronautical engineering data and government specifications for various kinds of conduit and tubing. Sections are devoted to flexible shielding conduit, conduit fittings, ferrule attaching machines and other aircraft products. *The American Brass Company.*

Gas Protection

Protection Against War Gases in Industrial Plants. Ward L. Mould. This is the first in a series of articles by the United States Office of Civilian Defense dealing with the wartime protection of industrial workers. The writer explains the nature of the various kinds of war gases, how they can be detected, the importance of immediate attention to prevent injury, and the necessity for seeking shelter as soon as the gas is detected. It is pointed out, however, that there is no immediate serious danger from exposure to any known gas. When exposed, the importance of washing the hands, face, and the rest of the body as soon as possible and also bathing the eyes with a solution of baking soda and water is emphasized. *North American Skywriter*, July 10.

Glider Industry

Gliders Go to Work. Attention is directed to the growing importance of the glider industry in southern California. Information is given on the types of gliders that have been produced in recent years, together with some information on the performance of locally built gliders. Comments are made on the materials used in manufacturing these machines and on other factors affecting their production. *Los Angeles County Aviation Progress*, July.

Goodyear Airplane Manual

This manual is intended for the use of those technically concerned with the manufacture, operation and maintenance of airplanes. It is offered as a source of installation and service data on Goodyear aircraft tires, tubes, wheels, and brakes.

As a prelude to the main contents of the manual, Goodyear's contributions to aviation progress are outlined and illustrated, and the company's test laboratories, including a fleet of airplanes for flying tests, are described. A descriptive coverage of Goodyear aircraft products, which include tires, multiple disc brakes and wheels, follows. Technical details and service operations are then taken up. Many tables of service, operation and other data are provided, together with dimensional drawings of parts. *Goodyear Tire and Rubber Company.*

Highways and Airport Runways

A book entitled *Better Bases for Better Surfaces,* containing information on the design and construction of bases for highways and airport runways, has been announced. It condenses information from recent reports that show the varying amounts of compaction and density necessary to assure ultimate stability of various types of graded aggregate bases. Information also is included on methods to insure proper density and at the same time effect substantial savings in water and compactive effort. Other sections cover the treatment of bases for frost prevention and specifications used in the construction of bases with various types of materials. *Solvay Sales Corporation*, New York.

Huge Flying Boat

Yesterday's Dream Flies. An illustrated article on the Martin Mars aerial transport, said to be the largest flying boat built to date. A test flight of this Wright Cyclone-powered seaplane was conducted recently. Strictly an aircraft of war, it carries machine gun nests and armament. It has a weight of 140,000 lbs. and an overall length of 117 ft. *Trade Winds*, August; "Maiden Voyage of the Mars," *The Martin Star*, August.

Low-Temperature Welding

A catalogue describing the Castolin Eutectic low-temperature welding system and the products offered for this method of welding has been published by Eutectic Welding Alloys, Inc. The system somewhat resembles brazing but differs from it in that alloys similar to the parent metal are applied, although the technique is like brazing. The weld is stated to have physical properties closely matching those of the parent metal. For each parent metal a special alloy rod is required which must melt and bind easily at low temperatures and also possess color, strength and physical properties closely resembling the parent metal, it is explained. *Eutectic Welding Alloys, Inc.*, New York.

Magnesium Welding

New Methods of Welding Magnesium Developed by Northrup Engineers. Highlights of an address by Thomas E. Piper, of Northrop Aircraft, Inc., to the American Welding Society. Methods developed for the arc welding of magnesium make available to aircraft manufacturers the same saving in time which has been experienced in welded ship construction, it is stated. Doing away with a multiplicity of rivets reduces manufacturing time and also eliminates parasite drag. New methods of extracting magnesium will make available almost unlimited quantities of this metal, and the welding methods developed will make possible much more extensive use of this light material in aircraft manufacture. *The Northrop News*, June 30.

Metal-Forming Machines

A revised catalogue, designated as No. 42-2, describes the machines used in the Di-Acro system of metal duplicating without dies. The various models

Through This One Cannon Plug Pass The Important Engine Circuits On Most American Planes . . .

This Cannon Type AN Connector is often used as the master engine "disconnect." It carries fifteen circuits from twelve different types of engine controls and instrument transmitters to the pilot's controls and indicators.

With this precision-built connector the maze of vital electrical circuits for the power plant can be carried with absolute security . . . yet all of these circuits can be broken instantly for routine service or major engine overhauls.

Cannon pioneered in the aircraft field with the Types AF, FM and K Connectors which are used throughout the world on all types of planes. Twenty-seven years of Cannon specialty manufacture in the electrical field has made Cannon's interpretation of the AN specification an outstanding product for America's fighting planes.

Cannon Connectors of various types have become standard equipment for aircraft instruments and accessories as well as for the wiring systems of the planes themselves. They are also used in countless fields where electrical connections must be made with absolute certainty.

CANNON ELECTRIC DEVELOPMENT COMPANY
LOS ANGELES, CALIFORNIA

of machines produced are shown and their application to the duplicate forming of metal parts is explained. Two new models brought out to meet the demand for machines with a greater capacity range are described. *O'Neill-Irwin Manufacturing Company*, Minneapolis.

Multiple-Angle Drills

Multiple-angle drills, screwdrivers and nut setters are described in Bulletin No. 88, issued recently. Photographs of the tools are shown and a table of specifications is furnished. *Cleveland Pneumatic Tool Company*, Cleveland.

Navy's New Scout Plane

Here's the Sea Ranger. An account of a new type of experimental flying boat recently turned out by Boeing for the Navy. Designated by the Navy as XPBB-1, it is in the weight class of four-engined airplanes but is powered with only two, which are believed to be the most powerful aircraft engines produced to date. It is designed as a long-range scouting plane, capable of destroying enemy submarines and surface vessels, and is heavily armed. Living quarters provide accommodations for a crew of ten men. Performance figures of the Sea Ranger are not given, but the plane is expected to fly further and carry a larger bomb load than any plane now in Naval service. *Boeing News*, July.

Plywood Finishing

Finishing of Resin-Bonded Plywood for Aircraft Construction. Roy B. Anderson. Qualities necessary in a finish for resin-bonded aircraft plywood are described, and "built-up" finishing systems together with the proper methods of applying coatings are explained. Essential requirements for coatings are durability and resistance to cracking, checking or grain raising when exposed to the elements, and temperature changes. Each coating should be formulated to meet specific needs and to provide the proper surfacing or base for the following coat so that the final or built-up finish gives the full range requirements, it is stated. *Bakelite Review*, July.

Precision Lathes

Precision lathes are described in Catalogue No. 17, published by the South Bend Lathe Works. This 8-page catalogue illustrates and describes South Bend 16-in. toolroom lathes and 16-in. quick-change gear lathes. Attachments, accessories and tools for use with these lathes are also listed, and construction features of the lathes are illustrated. Specifications are tabulated for ready reference. These lathes have 16½-in.

swing, 1-in. collet capacity, and are made in several bed lengths providing between-centers capacities from 33½ to 105½ in. *South Bend Lathe Works*, South Bend, Ind.

Propeller Stress Machine

Keystone Engineers Discover Astounding Speed-Up Device. John H. O'Connell. Describing how a "brain machine" has been used by engineers of the Curtiss-Wright Corporation to speed up the design of propellers for fighting planes. With this machine, the time required to determine the stress characteristics of a propeller blade has been cut, in some cases, from 3 days to 4 min. and the degree of inaccuracy from about 3 per cent to one-tenth of 1 per cent, it is stated. Formerly, it took the engineers from 1 to 3 days to solve the linear second order differential equations, with variable coefficients, in order to determine the bending moments and ultimate stress in the blades. *The Blade*, July 10.

Remote Controls

Hydraulic remote controls are described in Bulletin EHC-78-C. Sperry Exactor controls are suited to installation on aircraft engine test stands, as throttle, mixture and supercharger controls, and are stated to be standard equipment on test stands of the U.S. Army Air Forces. They also are said to be in service on many airplanes of the British Royal Air Force. Information on applications, methods of mounting and dimensions are furnished in the bulletin. *Sperry Products, Inc.*, Hoboken, N.J.

Screw Products

A new screw products catalogue has been announced, in which all items have been made to conform to the revised suggested stock size lists in accordance with maximum price regulation No. 147 of the Office of Price Administration, dated May 23, 1942. This catalogue covers the needs of the screw products industry and is sectionalized for easy reference, there being one complete and twelve sectionalized indexes. The catalogue contains list prices, technical data, weights and dimensions of the various products. One entire section is devoted to AN products for the aeronautical industry. *Manufacturers Screw Products*, Chicago.

Superchargers

G. E. Pioneered in Developing Superchargers. Early and recent advances in the development of superchargers for aircraft engines are outlined. Superchargers now produced in this country make possible flights to an altitude of nearly 7 miles, it is stated. Army demands for exhaust-driven superchargers have necessitated a large expansion in production facilities for these devices in General Electric plants. Photographs show turbosuperchargers in process of manufacture. *The G. E. Monogram*, July-August.

Temperature Control Instruments

The current issue of the house magazine of Wheelco Instruments Company carries an article on the use of temperature control instruments in a heat-treating plant in midwestern United States. It refers to an unusual temperature control application on a multiple-burner furnace, designed to maintain even heat throughout the furnace regardless of heat losses at the doors. The installation may be applied to other types of furnaces and ovens in different branches of the metal industry. *Wheelco Comments*, June-July.

Tool Steel Handbook

Tool Steel for the Non-Metallurgist is a booklet explaining the characteristics of the different types of tool steels, outlining the purposes for which each is best adapted and giving suggestions for heat-treatment. The first chapter covers water hardening. The characteristics of oil hardening and air hardening tool steels and high-speed steels are discussed in the second chapter. The third chapter gives suggestions for the heat-treatment of the four basic types of tool steels. In the final chapter the quenching and tempering of tool steels are considered and paragraphs are added on grinding. *Crucible Steel Company of America.*

War Accomplishments

Let's Have a Look at the Record! John J. Foy. An article is presented in the form of a narrative covering the exploits of Curtiss P-40 fighters in the different theaters of war throughout the world, quotations from press reports being used extensively. The P-40 is really six different planes, it is pointed out, the later models being far superior to the first members of the series in both speed and fire power. The first models of the series constituted only 6 per cent of the total production and were merely forerunners of the modern versions. The British named the early model Tomahawk and later models in the series Kittyhawk. The first model was armed with only two 0.50 caliber machine guns and two 0.30 caliber wing guns. Successors, up to the P-40D and P-40E with improved Allison engines, and the P-40F (Warhawk), with American-built Rolls-Royce engines, represent a rapid development. These later models carry six 0.50 caliber machine guns. The article continues with descriptions of how the P-40 bested enemy planes in various actions. *Curtiss Fly Leaf*, April-May.

Water Absorption Data

A 3-page bulletin is devoted to the subject of water absorption of Plexiglas. It gives data on the permeation of water vapor through this material. Information is presented which should be of interest to engineers concerned with the design of pressurized cabins, in connection with double Plexiglas glazing and the installation of various dehydration devices to reduce cabin humidity. *Rohm & Haas Company*, Philadelphia.

Waterproof Glues

Data sheets on waterproof resin-wood glues to meet the new Army and Navy aeronautical specifications have been issued. Glues for aircraft waterproof plywood, assembly and joint work and vacuum bags are covered in a chart. Cold-setting urea resin glues suitable for aircraft assembly, skis, life floats and other equipment are covered in Technical Bulletin 103. *Casein Company of America*, New York.

Welding Economy

A new 14-page booklet has been designed to help arc-welding operators accomplish more work with each electrode used. It consists of a series of shop posters each of which illustrates a common wasteful practice and shows the corresponding good practice, pointing out the ease and simplicity of doing the work in the proper way. The posters can be detached from the booklet for display in the shop. *Air Reduction Company.*

Weston Aircraft Instruments

A detailed catalogue has been made available, covering electrical instruments for aircraft. It gives fundamental and general information about electric circuits and the instruments used, followed by detailed data on ammeters, voltmeters and voltammeters, tachometers, temperature indicators, mixture indicators and other electrical aircraft instruments. A chapter is devoted to servicing and in the supplement the radiometer principle of temperature measurement is explained. *Weston Electrical Instrument Corporation*, Newark, N.J.

Electronics Chart

A quick selection chart of electronic tubes for industry, with technical data on applications and tubes, has been prepared by the Radio, Television and Electronics Department. *General Electric Company.*

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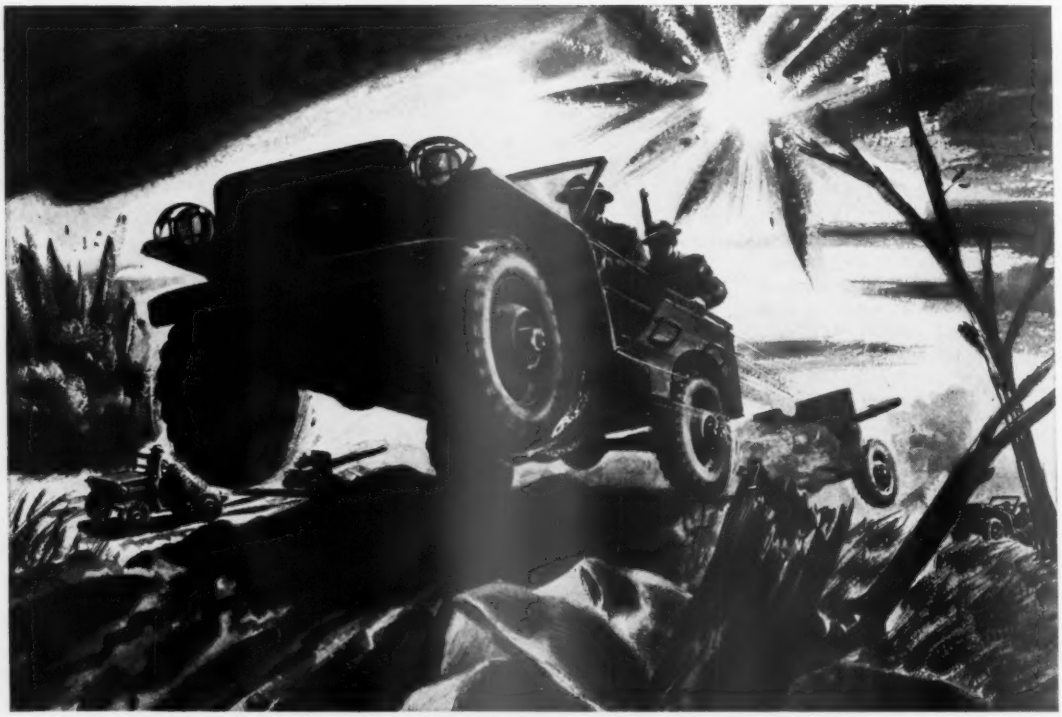
has gone to War



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From the Industry

American Instrument Company

A new instrument, the McKee Wear Gauge, for measuring the amount of material removed from metallic surfaces after such surfaces have been subjected to wear, abrasion, grinding, honing, lapping or similar operations in engine cylinders and pistons, crankshafts and bearings, cams, cam shafts and bearings, and push rods, has recently been announced.

Maximum amount of wear that can be measured is 0.0014 in.; minimum detectable wear (sensitivity is 0.000015 in.), 15 millionths of an inch.

With this gauge, measurements can be made: (1) on the inside surfaces of cylinders having a minimum diameter of $2^7/_{32}$ in.; (2) on flat surfaces; (3) on the outer surfaces of cylinders down to $^1/_{32}$ in. diameter; (4) on spheres down to $^1/_4$ in. diameter. Measurements are possible at any distance on the inside of a cylinder up to 10 in. from the end of the cylinder and on any accessible spot on the outer surface of flats, cylinders, or spheres.

The principle of operation is as follows: A diamond-shaped pyramidal indentation is made in the surface on which the amount of wear is to be measured. The depth of the indentation is a function of the peak angle of the indenter point. This angle has been accurately measured, and thus, by measuring the initial length of the base of the indentation, application of a factor will give the initial depth. As wear takes place, the entire diamond-shaped indentation becomes smaller (shorter). After wear has taken place, a second measurement of the length of the base of the indentation will show the amount of material that has been removed from the test surface.

The McKee Wear Gauge consists of four main parts: (1) indenter, (2) measuring microscope, (3) cylinder indentation locator, (4) polishing template.

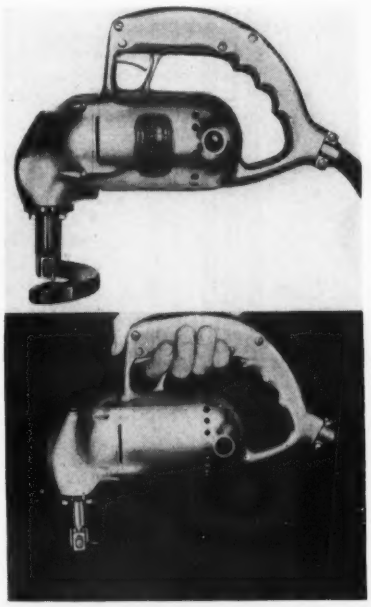
Each instrument is supplied with a multiplying factor for converting microscope readings to indentation depth (the depth that would result if the surface were flat). If the surface is curved, correction must be made to the depth measurement by referring to a correction formula and table supplied with the instrument.

Black & Decker Manufacturing Company

Both their 16-gauge and 18-gauge Lectro-Shear have been redesigned by the Black & Decker Manufacturing Company to improve their ease of handling and operating characteristics.

The No. 18 Lectro-Shear has been reduced in outer dimensions so that the motor housing forms a comfortable operating handle. This reduces the length and weight of this tool and improves the operating balance and control. The power and capacity of the tool are the same as in previous models, cutting up to 18-gauge sheet steel.

The larger No. 16 Lectro-Shear has been equipped with an improved operating handle that gives this tool better balance and easy control on curved and irregular lines. It is equipped with an instant release trigger switch with locking pin for continuous operation. The handle is so shaped that it can be used over the tool or at the rear end. The power and capacity of this tool are the same as in previous models, cutting up to 16-gauge sheet steel.



Black & Decker No. 16 Lectro-Shear.

Boots Aircraft Nut Corporation

Consisting of the sheet metal Wing Style nuts in combination with a curved channel strip, the Boots Curved Channel is a companion to the regular straight channel. It is available in standard semicircles with radii ranging from $2^3/_8$ to $11^3/_4$ in.

Like the straight channel it has a feature that permits nuts to be replaced quickly and easily by snapping one out of the channel and snapping another one in its place.

Ordinarily, this channel is furnished with nuts in standard regular spacing but, on special order, it can be supplied with irregularly spaced nuts to meet customers' specifications.

Bowlus Sailplanes, Inc.

Bowlus Sailplanes, Inc., recently announced, with the sanction of the War Department, successful test flights of what is said to be the nation's first all plywood-plastic glider, for the training of glider pilots.

The new Bowlus Glider was produced at the Bowlus parent plant in southern California. Plywood and other nonstrategic materials were used which, when molded with phenol and urea-type bonding in forms under hot and cold pressure, make a plywood-plastic of great strength and lightness and practically impervious to weather corrosion. The new glider is completely nonmagnetic; hence, the later war gliders will be practically free from the possibility of detection by enemy listening devices.

The initially tested glider is described as a two-place "transitional" trainer embodying developments in design which will characterize the cargo gliders to come. Performance data are naturally restricted, but the company has been permitted to disclose that the new glider trainer is not a sailplane. It comes within the category of gliders designated by the Army as Class I, which specifies a design speed of 100 miles per hour. The Bowlus Glider has a design speed of 112 m.p.h. In weight, wing loading and speed, it more than doubles the specifications of the Bowlus Albatross Sailplane.

Carboloy Company, Inc.

Designed primarily to facilitate the machining of steel parts in which cuts are of the interrupted type and of prime advantage on large machines, Carboloy Company, Inc., has established standardized designs of "shear type" tools to simplify production and use of such tools.

Shear type tools are characterized by a large negative back rake. This negative rake results in a shaving form of cut when used for turning or facing. Thus, when the tool is used for interrupted cuts, the impact load on the tool does not come at the end of the tip but farther back. Also, the entry of the cutting edge of the tool into the cut after each interruption is gradual, starting at the point of contact back from the tip and working forward to the tip of the tool.

These Carboloy shear tools have been in use for some time, particularly in connection with the machining of the newer tough alloy steels, and sufficient experience has now been accumulated to standardize optimum shapes and dimensions.

The line includes four basic sizes of tools in both left- and right-hand varieties, a total of eight types. Shank sizes include: 1 by 1; $1/4$ by $1^1/_4$; $1^1/_2$ by $1^1/_2$; and $1^1/_2$ by 2 in. Blanks for the new standard shear type tools are of special design.

Compressed Air Institute

Bomber part testing is claimed to have been speeded 400 per cent by a device known as a Comparator, which operates in connection with a Rockwell Hardness Gauge. This comparator is comprised of a table-mounted yoke that supports a penetrator placed over an anvil. The die end of the penetrator is the same size as that used in the Rockwell Gauge. The anvil moves upward against the penetrator under pressure of a piston operated by compressed air. A piece being tested is thus pressed against the spherical die with pressure sufficient to indent its surface. The depth of the indentation is shown by a Starret Dial Indicator, which records any upward motion of the die. A foot-controlled air valve allows the operator free use of both hands.

To test a number of similar parts one of correct hardness as determined by the Rockwell Gauge is used to calibrate the Comparator. This piece is subjected to pressure in the Comparator at which time the position of the indicator needle is noted. Subsequent pieces, if of proper hardness, will give the same reading.

Curran Corporation

Announcement is made by the Chemical Development Laboratory of the Curran Corporation, Malden, Mass., of a light "Polar K" oil, which is claimed to have the unique and valuable properties of completely removing moisture, water, oil and dirt from steel surfaces.

The new oil instantly displaces and absorbs water and leaves a thin film of Polar-type lubricant and rust preventive. The Polar oil is said to be especially applicable for protecting machinery and metal products during storage.

The fluid has also been found suitable for spraying on the inside of Diesel and gasoline engine cylinder walls that have accumulated a film of condensed moisture as a result of storage

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Curtiss-Wright Corporation

The importance to the United Nations of the new Curtiss (SB2C-1) Helldiver dive bomber, designed by Curtiss-Wright Corporation for the U.S. Navy was further emphasized with the announcement that Fairchild Aircraft, Ltd., of Longueuil, Quebec, Canada, has been licensed to build large additional numbers of this type.

The new Curtiss Helldiver is already being produced for the Navy in a Curtiss-Wright plant at Columbus, O. In addition, it is being built in large numbers by the Canadian Car & Foundry Company, Ltd., in St. Charles, Montreal, and in Forst Williams, Ontario.

The Helldiver is a two-place, all-metal, mid-wing monoplane powered with a 1,700 hp. Wright Cyclone 14-cylinder engine. While all details of its speed, armament and bomb-load capacity are withheld by the U.S. Navy, its designers say it is capable of high speed, is able to carry a larger bomb load farther than any dive bomber now in service, and is greatly superior in performance to the German Stuka type.

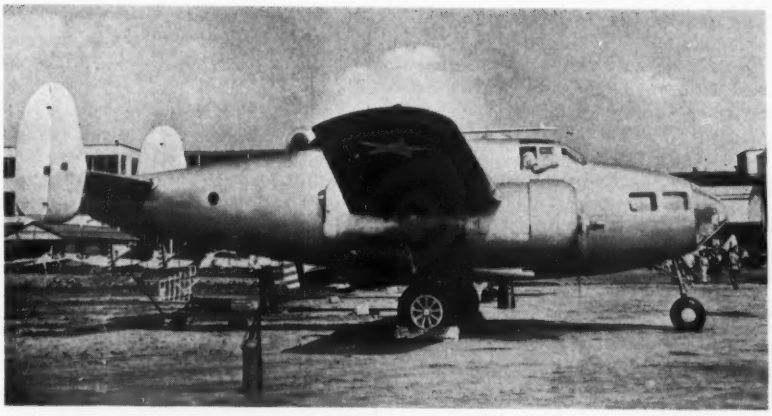
Elastic Stop Nut Corporation

A wall chart explaining the uses of its various types of self-locking nuts is being distributed by Elastic Stop Nut Corporation, Union, N.J., to engineering departments, drafting rooms, maintenance shops, and schools.

The center of the chart is devoted to an illustrated description of the basic principle by which a self-locking action is obtained in all Elastic Stop Nuts, regardless of type. This is followed by illustrations of some of the advantages to be obtained by the use of the nuts and, completing the presentation, there are cross-section drawings showing the method of application of the nine types most generally used, with corresponding photographs of these types. The chart measures 21 by 27 in.

Fairchild Engine & Airplane Corporation

The Fairchild AT-13, twin-engined crew trainer built entirely of Duramold (except for certain members supporting the bombing, machine gun, camera and other equipment) was recently flown in test. Though details of performance are restricted, the War Department has permitted it to be stated that the plane's speed is in the 200-m.p.h. category. With a wing span of 52 ft., 6 in., an overall length of 37 ft., $7^3/_8$ in. and a height (from the ground to the top of the vertical fin in flying position) of slightly over 13 ft., the plane is claimed to be one of the largest and fastest designed and built for training.



The Fairchild AT-13 twin-engined crew trainer. Except for certain members supporting the machine gun, camera and other equipment, the plane is built entirely by the Duramold process.

It was built to meet the necessity of training bombing crews as a unit. It provides places for bombardier in the transparent plastic nose, pilot and co-pilot in the cockpit, navigator-radio man beneath a special navigation hatch, machine gunner in a power-driven turret, and cameraman over vertical and angle camera hatches in the tail. The airplane is equipped with instruments to enable an entire training crew to simulate all of the conditions of a long-range bomber attack. As the plane is the first trainer of this type to be equipped with tricycle landing gear and is otherwise similar to tactical types, it will enable crews thus trained together to step into actual fighting craft as a well-coordinated team.

The principal characteristic of the new plane is the smooth exterior finish attained through the use of the Duramold process. It is without rivet heads or exterior fastenings of any sort. The after-part of the AT-13's fuselage is of true monocoque construction, all stresses being taken in the skin itself without the use of longerons or lateral stiffeners except those surrounding the openings.

While the wings are of more conventional interior construction using two spars and ribs—the wing skin is also of plywood and thermosetting resins molded into the necessary compound curves by the Duramold process. The wing skin itself is of sufficient thickness and consequent rigidity to maintain its true curve under flight stress with much less interior stiffening than usual and wholly without exterior fastenings, such as rivet heads or lap joints, thus eliminating drag factors that reach high values at the operating speed of such an airplane.

The only metal or other strategic material used is in the engine mounts and cowlings and in the tubular steel members on which the bomb racks, bombsight, machine guns, controls and instrumentation are mounted. The bomb bays are ample for full loads of medium size practice bombs.

Gas Gun Company, Inc.

An automatic acetylene torch that looks like a pistol is being introduced to Pacific coast war industries by the Gas Gun Company, Inc., of Salem, Ore. It is used for soldering, silver soldering, light brazing and lead burning.

The gas gun weighs only 20 oz., is $6^1/_2$ in. long, and $5^1/_2$ in. high. Being small, it is said to be valuable in aircraft work and shipbuilding where close quarters will not permit the use of other equipment.

The gas hose from the acetylene tank connects to the gas gun at the bottom of the piston grip handle. Ignition is made by pulling the trigger which strikes a spark from a flint similar to those used in cigarette lighters. Each flint is good for more than 500 ignitions, and an extra supply is carried in a special compartment in the breech of the gun.

The gun may be used for soldering and silver soldering, sweating terminals on electric cables, leading joints in plumbing departments, aluminum soldering in aviation plants, silver soldering pipe lines for refrigeration and oil lines in ship and aircraft construction, lead burning in battery shops, lead and silver soldering in sheet metal departments.

General Electric Company

A new line of heavy-duty a.c. welding transformers especially designed for Unionmelt welding has been announced. The welders are available in 750- and 1,000-amp. sizes (N.E.M.A.) for 220-, 440-, and 550-volt power.

Features of the line are built-in capacitors and built-in primary control. The capacitors are important for improving voltage regulation of the power feeders, thus aiding uniform welding. The built-in primary control not only simplifies wiring but is advantageous in portable installations because of its compactness. It includes a disconnecting switch and auxiliary transformer to furnish power for operation of Unionmelt auxiliaries.

Motor-operated, remote adjustment of the welding current permits an operator to make current adjustments without leaving the work. The equipment's integral reactance design permits full output to be obtained without the use of high or multiple open-circuit taps. Ample ventilation and the arrangement of ducts permits two welders to be mounted side by side without the need for extra space between them for ventilating air. The current output of each welding transformer is indicated by a large, calibrated scale on the front of the case. Inorganic (Class B) insulation is used throughout.

A new crater filler has been developed for use with the G-E Strikeasy arc welder. The crater filler—a foot accelerator for welders—is designed to provide the close auxiliary control of heat required in welding thin material, such as aircraft tubing, and to permit tapering off of the welding current at the end of a bead in order to fill the crater which is otherwise left.

The crater filler is essentially a combination of a foot-operated rheostat for reducing the current and a field forcing switch for providing a hot start or an increase in welding current when required. It is not intended to replace the function of the control on the Strikeasy but is used to increase or decrease the heat settling to accommodate abnormal conditions at the beginning or end of a weld or during a weld. Normal welding heats should be adjusted in the usual way.

The crater filler is particularly helpful when working with thin material where normal welding heats are low, as conditions frequently arise where normal welding heats are insufficient. At the start of a weld the electrode and base material are cold and fusion might be poor, with consequent pile-up of the deposited metal. A similar circumstance arises where the section to be welded suddenly becomes thicker or when it is necessary to weld into or across a previously deposited bead.

At the time of breaking the arc, the crater filler permits either a rapid or a slow decrease in current down to the point where the arc is extinguished. This assists the operator in mastering the technique of finishing a bead without a crater, because he can suit the rate of fading of the current to the conditions in that particular weld.

A new multicircuit switch that opens, closes, or transfers as many as 20 circuits simultaneously by means of a two-position operating knob has been announced by the General Electric Company for aircraft service.

The contact mechanisms used are G-E switchettes stacked in pairs. The switchette is snap action, double-break in construction, giving it a high current rating. The switch is available with from 8 to 20 switchettes and in either single-circuit or two-circuit form. A shaft toggle switch insures positive switch position.

The multicircuit switch meets specifications set up by the U.S. Army Air

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Forces for devices of this type. Weight varies from $5^1/_3$ to $10^2/_3$ oz., depending upon the size selected.

Gisholt Machine Company

Stimulated by industry's wartime production requirements for positive balancing equipment having extraordinary capacities, Gisholt Machine Company development engineers have broadened the overall range of the dynetric balancing machine line to extremes of 1 oz. and 50 tons. The range of effective static and dynamic balancing capacity is shown by the development of the new Gisholt floor-type dynetric balancing machine, built to balance parts up to 100,000 lbs. in weight, being 240 in. in length, with 200 in. swing, which has passed all tests and is shown in use, and the Gisholt Type S dynetric, first to be manufactured and smallest of the entire line, which has been perfected to balance parts weighing as little as 1 oz.

Goodyear Aircraft Corporation

Employing rubber in somewhat the same manner it is used to cushion automobile engines, engineers of the Goodyear Aircraft Corporation disclosed development of a new type of suspension mounts for airplane engines.

They said the new amounts offer four distinct advantages over previous types: (1) longer life for airplanes because of less vibrational stress on the structure and other parts; (2) greater fire accuracy, with gunners subjected to less vibration in their gun turrets; (3) more accurate aiming of bombs because of decreased vibration in instruments such as bombsights; (4) less vibration-inspired nervous strain on pilots, navigators, gunners and others on long flights.

Several types of suspension mounts, all using standard suspension rings with which engines and engine nacelles are equipped at present, were developed. They are adapted to varying engine weights and horsepower.

Gulf Oil Corporation

Machines making parts for airplanes, tanks, ships and guns are claimed to show increased production and longer tool life with the use of a new industrial cutting oil recently perfected by scientists at the Gulf Research Laboratories.

In one recent demonstration, the new oil, known as "Cut-Aid" was used on a machine that was throwing up a plume of smoke while operating at 100 surface ft. per min. After the new cutting oil was added to the cutting lubricant already in use, there was not a trace of smoke at 300 ft. per min. At the same time, production was increased, tool life extended and a better finish obtained on the work.

Releases are printed as received from companies and other aeronautical organizations and the responsibility for the accuracy of all statements is therefore not assumed by the Aeronautical Engineering Review.

In another operation, tool life was extended from 3 hours between regrinds to 11 hours in forming aluminum on a Brown and Sharpe automatic, reducing $^3/_4$ in. round stock to $^1/_4$ in.

It is said that the new oil has proved ideal for machining aluminum. With this oil, aluminum parts now can be machined so smoothly that in many cases they do not need to be polished, thus eliminating a full step in production.

The oil is also said to be excellent for cutting magnesium and nonferrous alloys and in many cases has set new standards of performance for this type of work, including finer finish, and cleaner, sharper and more accurate threads.

Harman Equipment Company

The newly designed Harman "Lube-A-Plane" is a portable field unit designed to pump and meter motor-oil directly from original, sealed refinery barrels to aircraft tanks. This is said to save intermediate rehandling, keep oil "sabotage-safe" from the entrance of abrasives, speed up servicing and reduce personnel requirements to only one attendant, who can load and move the unit either manually or by tractor. The same attendant can transfer the oil to the plane, since the flow—from complete shut-off to 6 gal. a minute—is regulated at the hose nozzle.

The cost of these units is said to be so low that ten or twelve of them may be purchased at the price of one tank truck. Scattered about an airfield, they are less vulnerable to attack than a single tank truck.

The unit is two pieces of equipment in one—a standard trailer and demountable self-contained pump, meter and manifold unit complete with suction and discharge piping and hose assembles, equipped with gasoline engine, electric motor or hand-operated pump, all mounted on a steel base which is bolted to the chassis. Removal of only four bolts makes it easy to demount for use elsewhere. For example, the electric unit may be interchanged with a gas or hand-operated unit in case of electric power failure.

The barrel tilting device enables a small bantam-weight man or an older worker unaccustomed to heavy labor, to load a 400-lb. barrel of oil on the trailer by means of a lever arrangement. This lever acts as a self-locking and tilting device and also serves as a brake against the tire during the loading process so that the trailer cannot go adrift. Adjustable and automatic clamps on the "tilter" accommodate themselves to barrels of various heights.

Special inlet nozzles, valves and couplings provide for maximum flow and drainage of barrels even when the viscosity of motor oil is sharply reduced by a drop in temperature.

In addition to the three-wheel, two-barrel gas, electric, or hand units described, there are also "Lube-A-Plane" units with four wheels and capacities of four or six barrels.

Harvill Aircraft Die Casting Corporation

The Hydraulic Division of Harvill Aircraft Die Casting Corporation has recently been organized and has taken over an entire plant in Los Angeles where Harvill Hydraulic products will be manufactured. The plant is now in production of the Model 66-2000 series of hand pumps, which conform to the S.A.E. aeronautical standards and are interchangeable with other pumps built to the same standards. Three models of the pump are in current production, all with $1^1/_2$ in. cubic displacement.

A feature of the Harvill Hydraulic Pump is the use of pressure molding, a production process pioneered by Harvill, for the pump body and fulcrum. It is claimed that the use of pressure molding greatly reduces the amount of machining normally required on pump bodies and at the same time is extremely light in weight. Including the handle and fulcrum assembly, there are only 13 different parts in the entire Harvill Hydraulic Pump.

Harvill Hydraulic Pumps of the 66-2000 series are available with mounting pads and port openings to meet customer specifications, which permits their interchange in current production aircraft. It is said that the pumps are now specified on certain Army Air Forces and U.S. Navy aircraft.

Kollsman Instrument Division Square D Company

A new step in instrument panel simplification was recently made by the designing of a Kollsman Combination Dual Tachometer and Synchroscope for twin-engined aircraft.

The new instrument is a three-in-one arrangement that combines in the space of one standard size instrument dial three instruments normally observed together. Synchronization can be quickly obtained by matching tachometer pointers with slight adjustments from the synchroscope.

The instrument has a standard size dial with two concentric pointers—one for each engine—and synchronization is indicated by the rotating subdial viewed through the window. Dual Tachometers, without Synchroscope, are also available.

The new indicators operate in the same manner as the standard Kollsman (Remote Indicating) Electric Tachometer and Synchroscope units. Standard Kollsman Electric Tachometer Generators are used and if desired, the new units can be used in combination with standard units.

Easy servicing is possible as the mechanism for either of the two motors or the Synchroscope can be removed from the instrument case without disturbing the other units. The new Dual Tachometers will be made available with either the standard 3,500 or 4,500 r.p.m. range.

Lane-Wells Company

A simple and rugged engine lathe tool holder that cuts tool changing time to approximately 5 sec., has been developed by the Lane-Wells Company.

The Kollsman combination dual-tachometer and syncroscope.

The Lane-Wells Universal Tool Holder consists of a tool post that can be fitted on to any engine lathe carriage compound rest. The detachable heads fit into a cylindrical member clamped into the tool post. Standard high-speed tool bits used for boring, turning, threading, facing or forming are fastened into the heads and each bit remains in place in the head. Drills and reamers can also be used.

In practice, the lathe operator has several heads, each carrying a tool to perform a certain operation on the stock. The first head is placed in the tool holder and locked in place by a quarter turn of the control handle. As soon as the operation on the stock is performed by the first tool, the operator releases the head, replaces it with the second head, locks it in place and is ready for the next operation. The change requires approximately 5 sec. After sizes are once established all readings can be taken from the cross-feed dials.

If a particular tool must be removed and then reinserted in the tool holder, the tool holder permits the original tool to be reinserted in the tool holder in exactly the same position it originally occupied. Work can then be resumed without the necessity of resetting the position of the tool holder relative to the work. The ordinary engine lathe, equipped with the Universal Tool Holder and a supply of detachable heads, makes possible any number of operations. The one tool holder will perform either outside turning or boring operations.

Four sizes of the device fit all standard makes of engine lathes from 10 to 24 in.

Lincoln Electric Company

An arc-welding inspection chart, intended to provide welding inspectors and others concerned with weld pro-

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Please fill my order for.....copies of WALLING & HILL Aircraft Mathematics, $1.25.

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duction with a simple aid for use in inspecting welds, has been published by the Lincoln Electric Company, Cleveland, O.

The chart graphically presents the different types of welds obtained when the work is done normally, with normal current, voltage and speed, as compared with those obtained when these factors are not normal.

Items to consider in inspection after welding include the size and shape of bead, appearance of the bead, undercut, overlap and location of craters indicating where the operator started and stopped welding. These conditions are illustrated by enlarged and detailed photographs on the chart.

Accompanying the photographs is a table indicating the burn-off of the electrode, the penetration of fusion, the appearance of the bead and the sound of the arc with each value of current, voltage and speed of welding.

McDonnell Aircraft Corporation

Working in cooperation with a large plastics manufacturer, a paper manufacturing company, and the Pulp and Paper Section of the Forest Products Products Laboratory, U.S. Department of Agriculture, McDonnell Aircraft Corporation has applied a strong paper impregnated with phenolformaldehyde to fabrication of many of the secondary and some of the primary aircraft structures currently manufactured from strategic materials such as aluminum and steel.

It is possible to use relatively light equipment for production with the new process utilizing paper plastic. Molding is done at 250 lbs. per sq.in. pressure, whereas prior to this development molding has been done at 1,000 to 2,000 lbs. per sq.in. Also, rather than the customary steel dies, McDonnell Aircraft Corporation is using the cheaper kirksite dies now used in aluminum fabrication. These represent a comparatively small capital investment in that they may be repeatedly remelted as design changes occur.

One of the parts which the company has produced experimentally using laminated paper plastic is a wing tip. The new paper plastic wing tip is composed of only 13 parts as compared to the 96 parts comprising the same wing tip when it is fabricated in aluminum.

Besides the saving in strategic materials and fabricating effort, the laminated paper plastic is claimed to have numerous other advantages. Among these are a smooth surface not involving the finishing and coating that metal and wood need, greater resistance to abrasion and denting than aluminum, adaptability to double curvature forms without special treatment and its uniformity. It can also be controlled to the advantage of design with slight taper or gauge variations.

The new Tinnerman right-angle Speed Clip.

The Glenn L. Martin Company

The entire flight deck and a large portion of the main deck of the Martin Mars is supercharged, permitting normal breathing without oxygen masks or tubes miles above the clouds. In addition, the entire crew enjoys at all times the benefits of modern air conditioning, however high into the frigid atmosphere above the earth the plane may range.

These twin features of supercharging and air conditioning contribute to the efficiency of the occupants by permitting them to work, fight, eat and sleep with the same comfort they would have on a surface vessel or on land.

The supercharging of this airplane is confined, for practical reasons, to that portion forward of the wings. It is done with an auxiliary engine that keeps the forepart of the plane pumped full of air. The engine pumping in air begins to operate at 8,000 ft., where ordinary breathing is still easy. Although it was not feasible to supercharge the whole vessel, the entire interior is air conditioned. This means that the air drawn in passes over hot coils, which warm it to comfortable temperature. The process is necessitated by the fact that the air high above the earth, even in the tropics, is frigid.

Because of differences in air pressure within the hull when the plane is at high altitude, it is necessary for a man moving from one end of the craft to the other to pass through a decompression chamber. This allows him to become accustomed gradually to the different atmosphere into which he is about to step. Oxygen stations are set up throughout the hull in case of emergency.

Tinnerman Products, Inc.

For blind, right-angle attachments, new angle anchor Speed Nuts have been developed. This new fastener combines a standard "U"-type Speed Nut with a cadmium plated angle bracket for right-angle attachments, where access is from only one side. Available for use with 6-32 and 8-32 machine screws and 4Z, 6Z and 8Z sheet metal screws, these angle anchor Speed Nuts also come in 86-, 90- and 94-deg. angles.

Providing the exclusive Speed Nut double-locking, spring-tension grip that permanently resists vibration, these fasteners are suited for the attachment of junction box covers, switch box covers, fairings and other angular attachments. Standard shape and rivet hole spacings make them interchangeable with other angle anchor self-locking nuts.

It is said that manufacturers can save assembly time and riveting operations by attaching name plates and instruction plates with Speed Clips No. 2994. It is necessary only to line up holes in plate with holes in structure and, with a simple assembly tool, drive the clips home. Rivets are unnecessary for attaching light fiber plates, but in other attachments $^1/_{16}$ in. AN 442-2 rivets can be driven into the clips, causing them to expand for greater frictional contact with the structure. These Speed Clips weigh but 0.14 lb. per thousand and fit into 0.086 in. diameter holes in structures from 0.025 to 0.125 in. thick.

Turco Products, Inc.

What is claimed to be a noninflammable, fast-acting, wax-free paint remover—Turco Stripper L-595—recently was introduced by Turco Products, Inc., of Los Angeles and Chicago, to meet wartime industry's demand for greater safety. It can be used near welding machines, electrical apparatus, grinding wheels and other equipment that generates heat and sparks. Other than proper ventilation, no special precautions are necessary when using this new stripper.

The paint stripper is said to be safe for use on polished aluminum alloy, anodized aluminum alloy, Alclad, polished steel, cadmium-plated steel, stainless steel, polished copper or magnesium alloy.

It is said that no after-cleaning is necessary. The surface is left suitable for refinishing without further preparation. The "lifting action" starts almost immediately upon application.

Data on Properties and Working of Free-Machining "KR" Monel

A strong, corrosion-resistant alloy suitable for machining parts which may be hardened by thermal treatment

The new INCO Nickel Alloy, "KR" Monel,* possesses the same combination of properties as "K" Monel.* Equally rustless and resistant to corrosion, it can be hardened by the same treatment to obtain the range of strength, ductility and hardness shown in table below. Like "K" Monel, this alloy is also non-magnetic. However, its machining characteristics are much superior to those of "K" Monel.

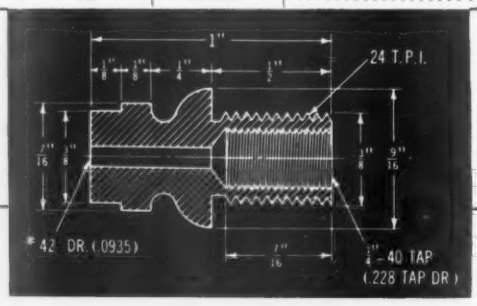
Machining data appear in the sketch and work sheet of operations on a practical job. For more detailed instructions, send for the new, revised edition of Bulletin T-12, "Machining Monel, Nickel and Inconel." Address:

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street New York, N. Y.

TABLE OF OPERATIONS

Operation	Rev. Per Min. Spindle	Rev. Per Min. Attachment	Surface Ft. Per Min.	Feed Inches	Remarks
Form	560	....	82	.00025	.....
Box Tool	560	....	82	.003	.....
No. 1 Drill	890	....	54	.002	L.H. Drill
No. 42 Drill	890	1600	60	.0015	L.H. Drill Drilling Attachment
Thread	560	308	25	.0416	Threading Attachment
Tap	560	183	25	.025	Tapping Attachment
Cut Off	560	....	82	.0002	.....

Material—9/16" dia. cold drawn as drawn (not age hardened) "KR" Monel
Machine—No. 2 B & S Automatic Screw Machine
Forward speed of spindle—560 R.P.M.
Backward speed of spindle—890 R.P.M.
Tool—high speed steel (18-4-1 Type)
Cutting lubricant—sulfurized oil



"Monel" and other trade-marks which have an asterisk associated with them are trade-marks of The International Nickel Company, Inc.

MECHANICAL PROPERTIES OF "KR" MONEL

Rods and Bars—Cold Drawn	Tensile Strength 1000 p.s.i.	Yield Strength (0.20% Offset) 1000 p.s.i.	Elongation in 2 in. per cent	Brinell Hardness 3000 kg.
Annealed	90-110	40-60	45-35	140-180
Annealed, age hardened	130-150	90-110	30-20	240-260
As drawn	100-125	70-100	35-15	175-250
As drawn, age hardened	140-170	100-130	30-15	260-320

INCO NICKEL ALLOYS

MONEL • "K" MONEL • "S" MONEL • "R" MONEL • "KR" MONEL • INCONEL • NICKEL • "Z" NICKEL

Sheet . . . Strip . . . Rod . . . Tubing . . . Wire . . . Castings

Institute News

Weather Research Project at Guggenheim Park

The first use of the Minta Martin Aeronautical Laboratory established by the Institute at Daniel Guggenheim Park through the recent gifts of Mrs. Daniel Guggenheim and Glenn L. Martin has been made by the U.S. Weather Bureau.

An important research project has been transferred from the Washington laboratories of the Weather Bureau to the Institute's newly acquired facilities at Sands Point, Long Island. The project is under the direction of Dr. L. W. Foskett, of the Weather Bureau's Instrument Division, and is being supervised by Charles H. Colvin, Director of the Daniel Guggenheim School of Aeronautics of New York University and Technical Adviser to the Chief of the Weather Bureau.

New Corporate Member

The General Electric Company, Schenectady, N.Y., is the latest addition to the list of companies affiliated with the Institute as Corporate Members. It has been active in various phases of aeronautical work since 1917. In the later days of the last World War, General Electric, together with the Army Air Corps, pioneered the development of the turbosupercharger, which it now produces for use on the engines of American military aircraft. The company is at present carrying out an extensive development program on cabin superchargers.

General Electric has been active for the past four years in the development of aircraft fire control systems involving power control for locally operated aircraft gun turrets as well as complete central fire control systems for aircraft. It is also engaged in the development and production of various items of aircraft electrical accessories such as engine-driven generators, motors, and various control devices and radio devices for aircraft use.

Sections and Branches

Seattle Section

Two guest speakers were heard by an audience of 150 persons at the meeting of the Seattle Section held on July 29. Lt. Colonel Wiley R. Wright, Army Air Forces Resident Representative at the Boeing Aircraft Company, presented an interesting discussion of his 25 years' experience in Army aviation. Colonel Wright's talk dealt mainly with his personal experience and ended with a forceful statement of his conception of the bright future of aviation and the vital necessity for all-out effort toward victory in the present conflict.

The second speaker, Capt. Felix Waitkus, who alone made the seventh successful flight across the Atlantic in 1935, gave an entertaining description of the technical and practical difficulties of his flight from its inception and added recollections of his personal reactions during the flight. Captain Waitkus answered a considerable number of questions after his talk.

H. T. Horn, Section Chairman, discussed the Institute's proposals on the membership grade of national Affiliate in relation to organized Sections and solicited comments from the floor.

Academy of Aeronautics

At a special meeting held on July 27 the color-sound film *Messerschmitt 110*, produced by Vultee Aircraft, was shown to Branch members. Three papers were presented at the July 29 meeting which was attended by all the senior members of the Branch. "The American Airship Situation Today," by Joseph Bellesheim, stressed the importance of the development of lighter-than-air ships. Oscar Williams gave a paper on "Comparison of the Rolls Royce Merlin and Allison V-1710 Engines." The final paper, "Soaring Meteorology," was by James Johnson.

The Aeronautical University

The Semi-Annual Banquet of the Branch was held at the St. Clair Hotel, Chicago, on August 6. Honorary Chairman Herbert W. Reed, acting as toastmaster, greeted the members and their guests and extended the best wishes of the faculty to graduating members. He expressed the appreciation of the Branch to the retiring officers—Charles H. Brunell, William Pinsley, and Narcyz M. Wasilkowski. Mr. Reed also spoke of the work of the Branch for next year and its participation in the Midwest Student Regional Meeting in 1943.

Leland W. Sims, Dean of Engineering of the Aeronautical University, addressed the gathering and stated that the activity and interest of the Student Branch had been one of the chief factors influencing him to become a member of the Institute. Joseph Gorman, Design Instructor, commented on the value of the Branch activities in helping students to visualize the practical side of engineering.

The main speaker of the evening was R. E. Peterson, Assistant Personnel Director of United Air Lines. He described the present work of the air lines in the war effort, their future and the opportunities offered. His talk was followed by an open discussion. The program concluded with the showing of colored slides of gliders with explanations and comments by Harry Smith, a student at Aeronautical University and an experienced glider pilot.

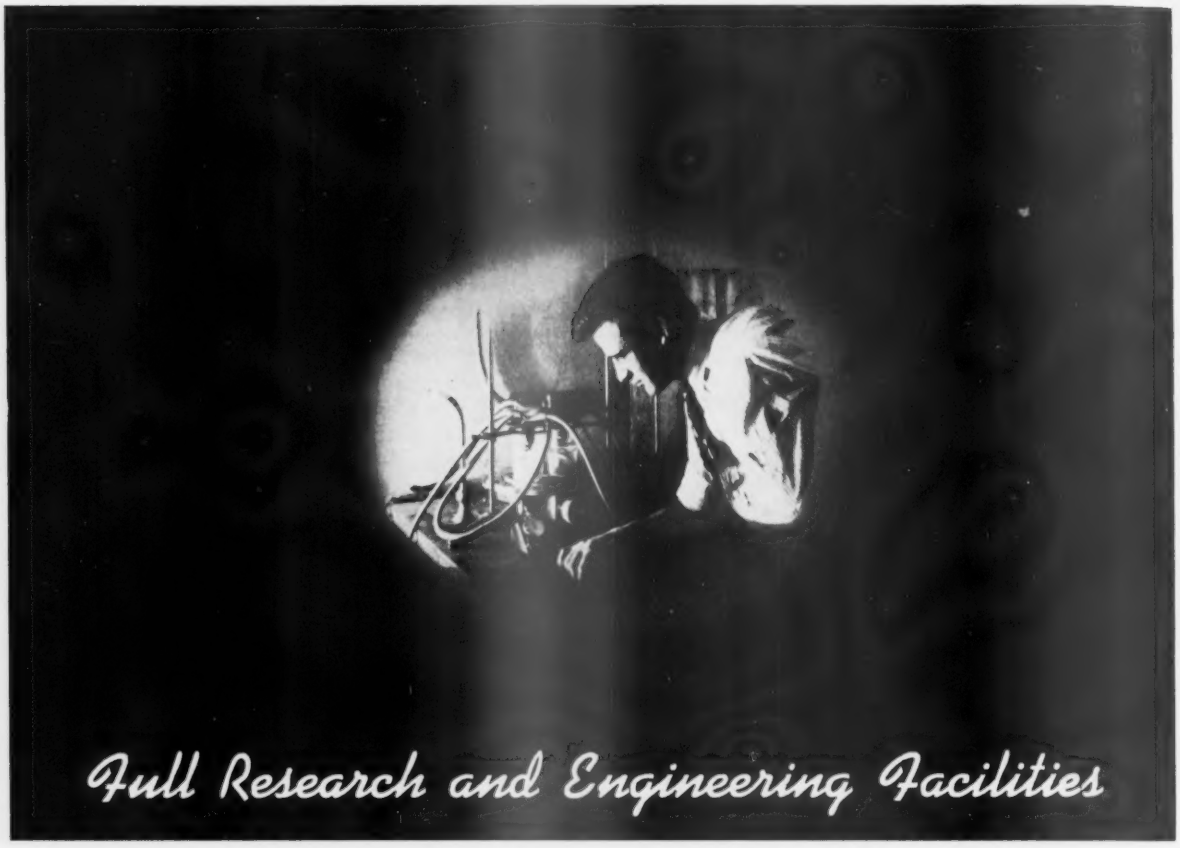
Alabama Polytechnic Institute

The I.Ae.S. illustrated slide film lecture on seamless tubing was presented at the Branch meeting on August 3. Jacque Houser, Assistant Professor of Aeronautical Engineering at Auburn, delivered the lecture and led the discussion that followed.

Carnegie Institute of Technology

The Branch held a picnic on June 12 at Allegheny County South Park. At its meeting on July 2 the motion picture film *Army Air Corps—1940* was shown. The Bell Aircraft film, *Cannons on Wings*, was shown on July 16 and was followed by a discussion of the problems of model glider design and construction.

A model glider contest sponsored by the Branch was held in Frick Park, Pittsburgh, on July 26 at which there



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were events for tow line and hand-launched gliders. Several members constructed models and participated in the contest.

Casey Jones School of Aeronautics

At the July meeting of the Branch the film *Messerschmitt 110* was shown to the entire Engineering Department of Casey Jones School. A discussion followed, chiefly concerning the simplicity of German aircraft design.

Later in the month a large number of the members of the Branch attended the Engineers' Moonlight Sail, an evening boatride up the Hudson River. Plans are in progress for the Senior Class Dance and for the Annual Banquet to be held in August, at which time emblems will be presented to new Institute Branch Members.

Indiana Technical College

Members of the Fort Wayne Civilian Pilot Training group were present at a regular meeting of the Branch on July 13. A paper on X-ray inspection of aeronautical castings was presented by Ronald Shreve. Virgil Kelley reported on the development and use of explosive rivets in airplane construction. After a brief recess the following films were shown: *Silent Wings*, *Wright Builds for Air Supremacy*, *Bell Airacobra* and *Cannons on Wings*. The completion of arrangements for a picnic at Hamilton Lake on July 26 was announced.

At a meeting on July 27 a paper on the development and use of plastics in the construction of aircraft was presented by John Ceccarelli. Chairman William Hazard, formerly employed as a jig designer at the Boston Gauge Company, gave a paper on the manufacture of aircraft gauges. The motion picture *Safe Flying* by the N.A.C.A., and a film, *The Battles of the Coral Sea and Midway*, were included in the program.

The Branch held its summer term banquet at the Wayne Hotel on August 10, at which special recognition was given to graduating members who were leaving to accept positions in the aeronautical industry. Honorary Chairman James Hailstones commented on the valuable work being done by the Branch and introduced the guests of honor—I. W. Baldwin, Head of the Aeronautics Division of the S. F. Bowser Company, and Bob Schott, radio commentator on aviation news and Manager of the Fort Wayne Municipal Airport. Mr. Baldwin gave a short talk on aviation after the war. Mr. Schott made his regular radio broadcast over Station WGL during the banquet and mentioned the activities of the Student Branch and the Institute over the air. Three motion pictures were shown at the conclusion of the program: N.A.C.A. films on airflow around an airfoil and on combustion in a test cylinder, and the Consolidated film *Building the PBY Record Breakers*.

Iowa State College

At the Branch meeting on July 15 the film *Eyes of the Navy*, depicting the progressive training of Naval Air Cadets and their active duties, was shown. Prof. W. C. Nelson discussed the film and spoke on the various positions open to graduates in aeronautical engineering, describing the relative advantages of each type of work. This was followed by a discussion of the history and activities of the Institute and its Branches by Chairman George Fuller. He then appointed the following committees: Banquet—Bob Ettinger, Roy Marker, Jr., Jack Phillips, Russ Pederson; Inspection Trip—George Fuller, Robert Tower, Jack Gearhart, Graydon Peoples, Milton Aginsky, Bob Gerber, Warren Kassel. Arrangements were announced for a permanent bulletin board for the I.Ae.S. Branch to be installed in the Aeronautics Building. The meeting closed with the presentation of an outline of the program scheduled for the coming year by Chairman Fuller.

Student Members of the A.S.M.E. were guests at the meeting of the Branch on August 5 at which the film *Messerschmitt 110* was shown with explanations by Professor Coan. Chairman Fuller gave a report on the proposed senior inspection trip. Bob Ettinger, Chairman of the Banquet Committee, reported on the prospective sources of speakers for the occasion. He also announced the rules of the Technical Paper Contest. Chairman Fuller announced that junior and senior representatives to the Engineering Council would be elected at the first meeting of the fall quarter. Merle Evers was elected Vice-Chairman to replace Harmon Ruliffson who had left school. The following volunteered for work on the Publicity Committee and on a committee to organize a picnic scheduled to be held near the beginning of the fall quarter: Robert Caswell, Edward Eales, Merle Evers, Jack Gearhart, Leonard Margules, and Harold Staab.

Secretary Tower called the attention of the members to the special rates for subscriptions to the JOURNAL and REVIEW, and to the privilege of using the Paul Kollsman Library. Professor Nelson pointed out the value of these publications and urged members to subscribe to at least one of them.

Massachusetts Institute of Technology

A dinner meeting of the Branch, at which three members of the faculty were guests, was held on July 15 in Pritchard Hall of The Walker Memorial. Two films, one on the N.A.C.A. free-spinning wind tunnel and the other on gliding activities at Elmira were shown. As an added diversion, two novel contests were held. One of these, the design of a "special airplane" to fly by any conceivable means, was won by Dick Morrison. The second, which entailed actual impromptu redesign of prepared models so as to attain a maximum distance of flight, was won by Larry Stewart. Activities Manager, Bob Lichten, prepared the program; Chairman Ben Williams presided.

The University of Pittsburgh

The motion picture film *Keep 'Em Flying*, describing Hamilton Standard propellers, was shown at a meeting on July 22. The Branch also sponsored the presentation of the film at Defense Training classes at the University of Pittsburgh.

Rensselaer Polytechnic Institute

At the July meeting of the Student Branch, Robert Hintermister presented a paper in which he pointed out the desirability of using the two-stroke engine to develop more horsepower per cubic inch of displacement. Motion picture films on the Goodrich deicer and on gliding at Harris Hill were shown. It was decided that the Branch would hold meetings every 2 weeks instead of every 3 or 4 weeks as formerly.

A. & M. College of Texas

At a meeting on July 2 the following Student Branch officers were installed: Chairman—Steve Kaffer; Vice-Chairman—Gene Clark; Secretary—Clifton Adcock; Treasurer—Gene Kipp; Senior Representative—August Lenert; Junior Representative—Jack Thomson. Two films, *Cyclone Combustion* and *Wright Builds for Air Supremacy*, produced by Wright Aeronautical Corporation, were shown.

E. N. Holmgreen, Acting Squadron Commander of the local Civil Air Patrol and business manager of Texas A. & M., spoke on the work of the C.A.P. at the Branch meeting on July 16.

R. T. Shiels, Dallas representative of General Electric Company, showed a series of films (*The Inside of Arc Welding*) to the Branch members on August 6. This series is used in the instruction of arc welders. He also showed lantern slides illustrating the use of electrical equipment in the aviation industry.

News of I.Ae.S. Members

J. S. Allard, M.I.Ae.S., has taken leave of absence from the Curtiss-Wright Corp., with which he has been associated since 1928, to serve in the Army Air Forces as a Lieutenant Colonel. A veteran flier of World War I, Colonel Allard was President of Curtiss-Wright Export Corp. and later Vice-President in charge of the Export Sales Division of Curtiss-Wright Corp.

John F. Bell, formerly a Draftsman with Vought-Sikorsky Aircraft Div., United Aircraft Corp., is now taking Aviation Cadet training for Engineering Officer in the Army Air Forces.

Recently appointed Chief of Structures for Bristol Aircraft Div., Universal Moulded Products Corp., is **Vincent J. Berinati,** formerly an Engineer with Howard Aircraft Corp.

Called from reserve status to active duty and promoted from Major to Lieutenant Colonel, **Victor E. Bertrandias,** M.I.Ae.S., has left Douglas Aircraft Co. for an undisclosed assignment with the Army Air Forces. He served with the Lafayette Escadrille during World War I and remained with the U.S. Army Air Corps until 1929 as Chief Inspector of the Engineering Division at Wright Field and then as Western Procurement District Supervisor. He established several aviation records during his military service and is believed to be the first American to fly an autogiro. Colonel Bertrandias joined the Douglas Company in 1933 as Export Sales Manager and became a Vice-President in 1938. He was in charge of the company's greatly expanded procurement program and wartime collaboration with the automobile industry until his recent return to military duty.

The newly formed Wings Club has opened its headquarters in the Yale Club of New York City under the presidency of **Caleb S. Bragg,** M.I.Ae.S., early flier and recently an organizer of Langley Aviation Corp. **Reed M. Chambers, C. S. Jones, Earl D. Osborn** and **Juan T. Trippe** are Institute members on the Council of the Club. The Wings Club provides for resident, nonresident and service members who are qualified pilots and a limited number of nonpilot affiliate members, to whom all the privileges of the Yale Club are made available.

Thomas A. Cheatham, Jr., has left the Navy Bureau of Aeronautics, where he was a Junior Aeronautical Engineer, to become a Flight Instructor, Army Primary School, Dovy Field.

Lt. M. E. Collins, M.I.Ae.S., recently reported for active duty at the Detroit U.S. Naval Reserve Aviation Base. He had been Professor and Head of the Department of Aeronautical Engineering, Tri-State College, and was Honorary Chairman of the I.Ae.S. Student Branch there.

J. S. Allard.

Col. J. Carroll Cone, M.I.Ae.S., Assistant Vice-President of Pan American Airways System, Inc., has been awarded the degree of Doctor of Laws by the University of Arkansas, his native state.

Formerly Assistant Instructor in the School of Mechanical Engineering, Purdue University, **Frank M. Crosby** is now a Flight Engineer with Bell Aircraft Corp.

Herbert A. DeCenzo has left Northrop Aircraft, Inc., where he was Chief Aerodynamicist, to become Chief Engineer of American Aviation Corp., recently formed at Jamestown, N.Y., for the construction of plywood airplanes and gliders. This company has arranged production contracts with six local furniture companies that have organized themselves as the Jamestown Aeronautical Corp.

William R. Dunbar has been promoted from Student Engineer to Power Plant Engineer at the El Segundo Div., Douglas Aircraft Co.

Vernon G. Emrich has joined Franklin Sailplane Co. as an Engineer. He was previously with the Mercury Aircraft Co. and also served as Engineering Salvage Supervisor, Airplane Div., Curtiss-Wright Corp.

Victor E. Bertrandias.

Chong-Hu Go, who recently received the degree of M.S. in Aeronautics from California Institute of Technology, has become a Junior Engineer on the staff of American Airlines.

Edwin P. Hartman, M.I.Ae.S., Associate Aeronautical Engineer at the Ames Aeronautical Laboratory of the N.A.C.A., has been transferred to Santa Monica to be in charge of the western coordinating office recently established there by the N.A.C.A. for the purpose of maintaining closer contact with the aircraft industry in southern California.

William C. House, formerly Stress Analyst and Test Engineer for Northrop Aircraft, Inc., is now a Research Engineer, Bureau of Aeronautics, Navy Department.

Thomas H. Huff, A.F.I.Ae.S., recently Design Engineer with The Glenn L. Martin Co. and Instructor in Aeronautical Engineering at Johns Hopkins University, is now Manager of Aircraft Products for Brasco Manufacturing Co. He has been active in aviation since 1915 when he graduated from Massachusetts Institute of Technology and served on the faculty of M.I.T. and the engineering staffs of Sturtevant Aeroplane Co. and Standard Aero Corp. during the years of World War I. Mr. Huff has been associated with the Naval Aircraft Factory, Huff-Daland Airplanes, Inc., Fokker Aircraft Corp., and General Aviation Corp. As Engineering Director of Tuscar Metals, Inc., and in a consulting capacity for other organizations, he made contributions to spot welding and other methods in stainless steel and aluminum aircraft construction and has designed over forty different types of aircraft.

Harvard L. Hull, A.F.I.Ae.S., has been Chief Engineer of the Special Ordnance Plant, York Safe and Lock Co., since June of this year. He had been a Research Engineer on the staff of the Sperry Gyroscope Co. since 1933 and, until recently, was Research Director for the company.

Formerly an Apprentice Engineer with Pan American Airways System, **Donald L. James, Jr.,** is now Project Engineer, Pan American Air Ferries.

Edward Kaplan has been promoted from Aeronautical Draftsman to Flight Engineer, Flight Test Group at Consolidated Aircraft Corp.

Lt. Comdr. Denys W. Knoll, M.I.Ae.S. who was in the last group evacuated from Corregidor before its surrender in May, is now in Washington as Officer-in-Charge of the Navy Weather Central. His meteorologic experience has included two and one-half years of naval duty in the Far East and the South Pacific. He was Aerological Officer with the Asiatic Fleet and then Officer-in-Charge of the Weather Central at the Cavite Navy Yard, in which capacity he continued to serve until the evacuation of Corregidor.

Jerome Lederer.

Harry G. Kottke is now Assistant Chief Engineer of the Peter Pirsch & Sons Co. and Senior Draftsman for Goodyear Aircraft Corp.

Director of the Safety Bureau of the Civil Aeronautics Board since June, 1940, **Jerome Lederer,** A.F.I.Ae.S., has resigned to accept the post of Executive Assistant to Sam Solomon, recently designated by the air lines as Director of Training for the greatly expanded program of world-wide air transportation which they have undertaken for the Army Air Forces Air Transport Command. He will assist in setting up the organization to train the many more thousands of pilots, flight engineers, and communications, maintenance and other operations personnel needed for this effort. In addition to his achievements as Director of the Safety Bureau, he has been well known to aviation circles for years through his activities as Chief Engineer of Aero Insurance Underwriters, whose technical staff he joined in 1929. His reports before safety conventions and aeronautical meetings have been widely pubished and contributed greatly to the development of safer air travel.

Joseph C. Lee has joined the staff of American Airlines as a Draftsman at its base at LaGuardia Field.

Harlowe J. Longfelder, formerly Wind-Tunnel Assistant at California Institute of Technology, is now an Aerodynamicist on special problems at Boeing Aircraft Co.

Flight Capt. H. A. Maurenbrecher, M.I.Ae.S., Test Pilot and Purchasing Officer for the Netherlands Purchasing Commission in the United States has been assigned to the Royal Netherlands Military Flying School in Mississippi.

Formerly Stress Engineer for the Glenn L. Martin Co., **Virgil D. Moss** has become a Senior Stress Analyst with Lockheed Aircraft Corp.

Marshall Nesbitt, a recent graduate of the University of Pittsburgh, is now an Engineer in the Aerodynamics Dept. of Douglas Aircraft Co.

Kenneth G. Merriam, A.F.I.Ae.S., is on leave of absence from Worcester Polytechnic Institute, where he was Professor of Aeronautics, for duty as a Major in the Coast Artillery Corps, U.S. Army.

Nicholas V. Mihailoff has been transferred from duties as a Junior Engineer with Pan American Airways System to Maintenance Personnel Instructor for the company's Alaska Division.

Elliott V. Mock has left Vultee Aircraft, Inc., where he was a Design Engineer, to take a similar position with Boeing Aircraft Co.

Henry T. Nagamatsu, who was recently on the engineering staff of Douglas Aircraft Co. and a graduate student at California Institute of Technology, is now a Theoretical Aerodynamicist with the Airplane Division, Curtiss-Wright Corp.

Phiroze P. Nazir, M.I.Ae.S., is with Aircraft Repair Ltd. of Alberta, Canada, as Designing Engineer. He was formerly in the Inspection Departments of Fairchild Aircraft Ltd., and the Aircraft Div. National Steel Car Corp. of Canada.

Alexander Nikolsky, A.F.I.Ae.S., has been appointed Associate Professor in the School of Engineering, Princeton University. He was Assistant Chief of Design, Vought-Sikorsky Aircraft Div., United Aircraft Corp., with which he had been associated since his graduation from Massachusetts Institute of Technology in 1929.

Boyd E. Quate, for several years a Meteorologist with Pan American-Grace Airways in Chile, has returned to this country and enlisted in the Army Air Forces.

Alexander Satin, M.I.Ae.S., who was recently Design Engineer, Consolidated Aircraft Corp., has joined the staff of the Ford Motor Co. as an Aeronautical Engineer.

Philip H. Schneck, M.I.Ae.S., formerly Production Planning Supervisor and Assistant Secretary, Propeller Div., Curtiss-Wright Corp., has been commissioned a 1st Lieutenant in the Army Air Forces, assigned to the Materiel Command.

Philip Shepley has left the Export Sales Div., Curtiss-Wright Corp., where he was Sales Engineer, for duty as a Major in the Army Air Forces.

Ensign Matthew E. Soennichsen, U.S.N.R., has been made Test Engineer (Structures) in the Aeronautical Materials Lab., U.S. Naval Aircraft Factory.

Roy E. Warren has been recently promoted to the rank of Major in the Army Air Forces.

Formerly Assistant Instructor at Rensselaer Polytechnic Institute, **William E. Wayman, Jr.,** has joined the General Electric Co. at Schenectady as an Aeronautical Engineer.

Roger T. Westvig has left Goodyear Aircraft Corp., where he was a Stress Engineer, to become a Stress Analyst on the staff of Vega Aircraft Corp.

Leon R. Wosika, formerly with Douglas Aircraft Co., is now an Engineer with Dow Chemical Co.

Harry Zuckerberg, M.I.Ae.S., previously on the engineering staff of Platt-LePage Aircraft Co. and Chief of Research and Development for this company since January, is now Structural Design Engineer with Vought-Sikorsky Aircraft Div., United Aircraft Corp.

Members Elected

The following applicants for membership or applicants for change of previous grade have been admitted to membership in the grades indicated since the publication of the list in the last issue of the REVIEW.

Transferred to Associate Fellow Grade

Krzywoblocki, Maria Zbigniew, Dipl. Ing., M.S.; Project & Stress Engineer, Noorduyn Aviation, Ltd., Canada.

Liljencrantz, Eric, M.D.; Comdr. (M.C.), U.S.N.R.; Head of Aviation Section, Research Div., Bureau Medicine & Surgery, Navy Dept.

Elected to MEMBER Grade

Arnhym, Albert Alexander, M.S.; Chief Engineer, Pacific-Airmax Corp.

Byers, Horace Robert, Sc.D.; Assoc. Prof. of Meteorology, Univ. of Chicago (see A.M. of S).

de Chappedelaine, Jean, B. Litt.; Executive Asst. to Commanding Officer of Army Aviation Div., Netherlands Purchasing Commission.

Dill, David Bruce, Ph.D.; Lt. Col., A.A.F.; Research in Aviation Physiology.

Du Bois, Eugene Floyd, M.D.; Prof. of Physiology, Cornell Univ. Medical College; Mem., Comm. on Aviation Medicine, National Research Council (see W.W. in A.; A.M. of S.).

Eno, Donald Wayne, B.S. in M.E.; Jr. Pilot, Atlantic Div., Pan American Airways System, Inc.

Ferris, Eugene Beverly, Jr., M.D., M.S.; Assoc. Prof. of Medicine, Asst. Director, Dept. of Internal Medicine, Univ. of Cincinnati; Investigator, Aviation Comm., Office of Scientific Research & Development (see A.M. of S).

Jerome, Clayton Charles, M.S. in Ae.E.; Lt. Col., Div. of Aviation, U.S. Marine Corps.

Koch, Walter L., M.S. in Ae.E.; Instructor in Aero. Engineering, Cornell Univ.

Marks, Joseph David, Vice-Pres. & Chief Engineer, The Bolton Manufacturing Co.

Sears, Jack Francis, Design Engineer, Noorduyn Aviation, Ltd., Canada.

Shepard, Irving Anthony, B.S. in Ae.E.; Sr. Aerodynamicist, McDonnell Aircraft Corp.

Sims, Leland Woodson, M.S.; Dean of Engineering, The Aeronautical Univ., Inc.

Elected to Technical Member Grade

Carrier, Charles Roderick, B.Ae.E.; Ensign, U.S. Naval Reserve.

Clark, Perry A., B.S. in M.E.: Service Representative, United Aircraft Service Corp.

Davis, Samuel, S.M.; Stress Analyst, Noorduyn Aviation, Ltd., Canada.

Demer, Louis Joseph, B.S. in M.E.; Instructor in Aero. Engineering, Univ. of Notre Dame.

Feddersen, Edward Warren, Layout Draftsman, Consolidated Aircraft Corp.

Guth, Elmer Paul, Ae.E.; Hydraulic Engineer, Waco Aircraft Co.

Haynes, Alex L., B.S. in M.E.; Design Engineer, Stinson Aircraft Div., Vultee Aircraft, Inc.

Hull, Lewis Woodruff, B.S. in Chem.E.; Secretary, Fleetcraft Corp.

Kantor, Maxwell, B.Ae.E.; Jr. Engineer, Skydyne, Inc.

Myrick, Joseph Louis, Jr., Engineer, Airplane Div., Curtiss-Wright Corp.

Noble, John David, Asst. Supervisor, Production Illustrations Group, Douglas Aircraft Co.

North, Donald Christopher, Jr., B.S. in C.E.; Stress Analyst, The Glenn L. Martin Co.

Oconnicof, William Alexander, B.S. in Ae.E.; Liaison Engineer, Consolidated Aircraft Corp.

Pettingall, Charles Edward, Jr., B.S. in M.E.; Flight Analyst, Douglas Aircraft Co.

Rounds, George Louis, Design Engineer, Doak Aircraft Co.; Chief Engineer, Briegleb Sailplane Corp.

Schlegel, Iven Lee, Design Draftsman, Noorduyn Aviation, Ltd., Canada.

Ventura, Joseph John, B.S. in C.E.; Stress Engineer, McDonnell Aircraft Co.

Transferred from Student to Technical Member Grade

Acton, Stanley Manning, B.S. in Ae.E.; Detailer, Airplane Div., Curtiss-Wright Corp.

Barnes, Thomas H., B.M.E.; Apprentice Engineer, Boeing Aircraft Co.

Barter, Leroy Donald, B.S. in Ae.E.; Design Draftsman, Aero. Lab., Univ. of Washington.

Beeson, Robert George, B.S. in Ae.E.; Aviation Cadet, U.S. Army Air Force Maintenance Engineers.

Bernstein, Seymour Frederick, B.B.A.; Jr. Engineer, Eastern Aircraft Div., General Motors Corp.

Boddy, Lee Elmer, B.S. in Ae.E.; Jr. Aero. Engineer, Ames Aero. Lab., N.A.C.A.

Bowes, Gerald Marshall, B.S. in Ae.E.; Sr. Detail Draftsman, Lockheed Aircraft Corp.

Burnham, Lavon Cassius, Jr. Stress Analyst, Bell Aircraft Corp.

Carlson, Carl Lawrence, B.Ae.E.; Experimental Test Engineer, Pratt & Whitney Aircraft Div., United Aircraft Corp.

Carpenter, Adelbert, B.Ae.E.; Jr. Aero. Engineer, Naval Aircraft Factory.

Chen, Ou-Wen Winston, B.S. in Ae.E.; Drafting Engineer, Republic Aviation Corp.

Cole, Hermon H., Structural Design Engineer, McDonnell Aircraft Corp.

Dill, Douglas Gordon, M.S.; Engineer, Douglas Aircraft Co.

Dingeldein, Richard Charles, B.Ae.E.; Jr. Aero. Engineer, Langley Mem. Aero. Lab., N.A.C.A.

Drinkwater, William Dale, B.S. in Ae.E.; Instructor in Aero. Engineering, Univ. of Minnesota.

Dods, Jules Bovee, Jr., B.S. in Ae.E.; Jr. Aero. Engineer, Ames Aero. Lab., N.A.C.A.

Eberle, Robert Bernard, B.Ae.E.; Aerodynamicist, Vought-Sikorsky Aircraft Div., United Aircraft Corp.

Edelman, Leonard Benjamin, B.S. in M.E.; Asst. in Wind Tunnel, Harvard Univ.

Fay, Edwin Reed, M.S.; Apprentice Engineer, Vought-Sikorsky Aircraft Div., United Aircraft Corp.

Fischer, Roger Walters, B.S. in Ae.E.; Apprentice Engineer, Vought-Sikorsky Aircraft Div., United Aircraft Corp.

Fleisig, Ross, B.Ae.E.; Aero. Engineer, Vought-Sikorsky Aircraft Div., United Aircraft Corp.

Furlong, George Chester, B.Ae.E.; Jr. Aero. Engineer, Langley Mem. Aero. Lab., N.A.C.A.

Gillooly, Richard Peter, S.B. in Ae.E.; 2nd Lt., U.S. Army Air Forces.

Glauser, James Ernest, M.E.; Service Engineer, Bendix Aviation Corp.

Heyduck, Lawrence Eugene, Jr., B.S. in M.E.; Vultee Aircraft, Inc.

Innes, Charles Barron, Jr., Draftsman, Vought-Sikorsky Aircraft Div., United Aircraft Corp.

Jacoby, Donald R., B.S. in M.E.; Research Asst., Dept. Aero. Engineering, New York Univ.

Johnson, Arlo Franklin, M.S.; Aerodynamicist, El Segundo Div., Douglas Aircraft Co.

Johnson, Clyde Bayless, Jr., B.S. in Ae.E.; Draftsman, El Segundo Div., Douglas Aircraft Co.

Josephs, Lyman Colt, III, B.S. in M.E.; Detail Designer, Trojan Powder Co.

Knies, Walter John, B.Ae.S.; Flight Engineer Trainee, Pan American Airways System, Inc.

Kreitzberg, George Fredrick, Structural Design Engineer, McDonnell Aircraft Corp.

Kotowski, Bruno, B.S. in M.E.; Sectional Supervisor, Murray Corp. of America.

Ledbetter, Girvis Erwin, B.S. in Ae.E.; Engineer, Airplane Div., Curtiss-Wright Corp.

Leiserson, Charles Frederick, B.S. in Ae.E.; Aero. Engineer, Grumman Aircraft Engineering Corp.

Lesser, Murray Leon, B.S. in E.; Flight Test Engineer, Northrop Aircraft, Inc.

Marmentini, Enzo G., B.Ae.E.; 2nd Lt., Technical Branch, Chilean Air Force.

Maske, Edmund Blake, Jr., B.S. in M.E.; 2nd Lt., Ordnance Dept., U.S. Army.

Matteson, Thomas Dickens, B.Ae.E.; Ensign (A-VS), U.S. Naval Reserve.

McCollom, John Sylvester, B.Ae.E.; 2nd Lt., U.S. Army Air Forces.

Min, Lee Ben, B.S. in Ae.E.; Graduate Student, Aero. Research Lab., Univ. of Kentucky.

Moore, Robert Francis John, B.Ae.E.; Apprentice Engineer, Pan American Airways System, Inc.

Nelson, John J., B.S. in M.E.; Jr. Aerodynamicist, Boeing Aircraft Co.

Perkins, Albert Wallie, Apprentice Engineer, American Airlines, Inc.

Peterson, Lyndon Leroy, B.S. in M.E.

Ranson, Charles W., B.S. in Ae.E.; Aero. Engineer, Vought-Sikorsky Aircraft Div., United Aircraft Corp.

Reynolds, Francis Drake, B.S. in M.E.; Jr. Tooling Engineer, Boeing Aircraft Co.

Ringham, Rodger F., B.Ae.E.; Aerodynamicist, Vought-Sikorsky Aircraft Div., United Aircraft Corp.

Robertson, Leo Petrie, B.S. in M.E.; Clerk, Engineering Staff, National Steel Car Co., Canada.

Scherrer, Richard, B.S. in Ae.E.; Jr. Aero. Engineer, Ames Aero. Lab., N.A.C.A.

Schneyer, Raymond Irvin, B.S.E.; Asst. Aero. Engineer, Bureau of Aeronautics, Navy Dept.

Schroeter, Otto Eugene, B.S. in Ae.E.; Cadet, Infantry School, U.S. Army.

Snodgrass, Reuben, M.S. in Ae.; Seaman-2C (V-5), U.S. Naval Reserve.

Soike, Henry Eugene, B.S. in Ae.E.; Apprentice Engineer, Pan American Airways System, Inc.

Sokolsky, Oliver Marvin, M.S. in Ae.; Aerodynamics Dept., North American Aviation, Inc.

Stull, Donald Lee, B.Ae.E.; Production Trainee, Airplane Div., Curtiss-Wright Corp.

Swancutt, Robert Francis, M.S. in Ae.; Stress Analyst, El Segundo Div., Douglas Aircraft Co.

Tomren, Raymond Henry, B.Ae.E.; Engineer, Airplane Div., Curtiss-Wright Corp.

Tripp, Robert, Drafting, Lockheed Aircraft Corp.

van Damme, Joseph, M.Ae.E.; Jr. Research Engineer, National Research Council, Canada.

Weiberg, James Arthur, B.S. in Ae.E.; Jr. Engineer, Ames Aero. Lab., N.A.C.A.

Wells, Kenneth Givhan, B.S. in M.E.; Engineer, Boeing Aircraft Co.

Wilson, Robert Dolan, Apprentice Engineer, American Airlines, Inc.

Winker, Kevin George, B.Ae.E.; Apprentice Engineer, Pan American Airways System, Inc.

Zimmerman, Harold W.

Personnel Opportunities

This column is for the use of individual members of the Institute seeking new connections and organizations offering employment to aeronautical specialists. Any member or organization may have requirements listed without charge by writing to the Secretary of the Institute.

WANTED

Engineering Instructors wanted by approved school in Midwest. Furnish qualifications, experience and snapshot in first letter. Address inquiries to Box 152, Institute of the Aeronautical Sciences.

Draftsman, preferably with instrument experience, for work on confidential projects for Army and Navy having vital bearing on the War effort. Applicants must be able to satisfy F.B.I. regarding citizenship and loyalty prior to starting work. Residence and work will be in small town on Long Island. It is anticipated work will be permanent. Address inquiries to Box 157, Institute of the Aeronautical Sciences.

Aeronautical Engineer experienced in plywood aircraft manufacturing wanted by southern aviation company State experience and salary expected in first letter. Address Aviation Engineering, Inc., 1390 Blashfield Street, S.E., Atlanta, Ga.

The Army Air Forces has urgent need for personnel with an aircraft engineering and maintenance background. The prime function of this personnel will be the coordinating of Army Air Forces contractor efforts in the Central States in supplying maintenance data, maintenance parts and maintenance tools as contracted. Approximately three-fourths of the time of this personnel will be spent in the field. Interested applicants should file qualification briefs with the District Supervisor, Central Procurement District, A.A.F. Materiel Center, 8505 West Warren Avenue, Detroit, Michigan, marked Attention: District Air Service Command Liaison Officer.

Airplane Designers, Stress Analysts and Draftsmen needed for few vacancies remaining on engineering staff. At least two or four years' experience essential. Write for appointment stating education, experience, and salary. Snead & Company, Aeronautical Division, 421 Canal Street, New York, N.Y.

A Midwestern University has a vacancy on the regular teaching staff of the Department of Aeronautical Engineering. Applicants should have teaching, research, or industrial experience and be capable of teaching graduate courses in structures or aerodynamics. Rank and salary will be determined on the basis of applicant's qualifications. This would not be a "duration" appointment. Address inquiries to Box 167, Institute of the Aeronautical Sciences.

Stress man wanted to take charge modified Army and C.A.A. work for growing Ohio light plane manufacturer. Excellent working conditions. Permanent. Address inquiries to Box 162, Institute of the Aeronautical Sciences.

Instructor or Assistant Professor for Airplane Design, Stress Analysis and Modern Aircraft Structural Theory in order to fill existing vacancy in regular staff of Aeronautical Engineering Department at College Station. Must have degree in Aeronautical Engineering and practical experience in industry. Ample opportunity and encouragement are provided for research, as well as industrial contacts with the rapidly expanding aircraft industry in Texas. Rank and salary will depend upon qualifications. Applicants now employed in defense industry must obtain release by present employer before being accepted. Letter of application should include snapshot and photo together with personal data, educational background, and practical experience record in detail. Address communications to Howard W. Barlow, Head, Department of Aeronautical Engineering, Agricultural & Mechanical College of Texas, College Station, Tex.

AVAILABLE

Aeronautical Engineer (M.S.) desires position as project engineer or similar position with concern manufacturing light military or naval aircraft. Experienced in stress analysis, performance calculation, and has conducted research in stability and control characteristics. At present instructor in airplane design in engineering division of large flying school and flight student completing commercial pilot flight course. Familiar with requirements for civil and military primary training airplanes. Prefers project on trainer or light airplane involving difficult control problems at low speed. Age 25. Address inquiries to Box 159, Institute of the Aeronautical Sciences.

Aerodynamicist, with three years' teaching experience as Assistant Professor of Aerodynamics and seven years' recent industrial experience with leading concerns as research engineer in design and air transport, desires research and/or teaching position. Applicant is foreign born but will be eligible for naturalization in six months. Author of several scientific papers on aerodynamics and originator of dynamic propeller balancing method in use by U.S. operators. Address inquiries Box 163, Institute of the Aeronautical Sciences.

Aeronautical Engineer (M.S. in Ae.E.), presently engaged in research in a leading college, desires position with aeronautical concern. Welcomes appointment in the Near East. Willing to undergo special training prior to such appointment. Can speak languages of that region fluently. Address inquires to Box 164, Institute of the Aeronautical Sciences.

Aeronautical Engineer (Ae.E.), twenty-six years experience in the design and construction of various types of military and commercial airplanes. Thoroughly familiar with Navy procedure. Interested in administrative or executive position only. Address inquiries to Box 165, Institute of the Aeronautical Sciences.

Aeronautical Engineer (B.S. in M.E., 1932), M.I.Ae.S., with approximately seven years' experience in aeronautical engineering, including responsible jobs as layout, structural design and stress analysis engineer, liaison work and aerodynamicist, seeks position as Chief Engineer or one of equal responsibility. Particularly qualified to handle complete design of aircraft, either plywood or metal, to C.A.A., Army Air Forces or Navy specifications and requirements. Also some experience in engineering representative to subcontractors. Inventive ability and production minded. Small or new companies soundly financed or established companies expanding into the aircraft industry are especially solicited. Address inquiries Box 166, Institute of the Aeronautical Sciences.

Aeronautical Engineering Review

Directory of

Aircraft Products and Services

The companies listed in this directory contribute to the support of the Institute of the Aeronautical Sciences, the Journal of the Aeronautical Sciences and the Aeronautical Engineering Review through Corporate Membership dues or advertising or both.

The Institute will appreciate any consideration that members and subscribers can give to the products or services of these companies. It will be glad to assist in obtaining complete information on listed or any other products or services not included.

ADHESIVES

Catalin Corporation
United States Rubber Company

AIRCRAFT

Airplane Division (Buffalo Plants), Curtiss-Wright Corporation
Airplane Division (St. Louis Plant), Curtiss-Wright Corporation
Bell Aircraft Corporation
Boeing Aircraft Company
Consolidated Aircraft Corporation
Douglas Aircraft Company
Duramold Aircraft Corporation
Engineering & Research Corporation
Fairchild Aircraft Division, Fairchild Engine & Airplane Corporation
Fleetwings, Inc.
Goodyear Aircraft Corporation
Grumman Aircraft Engineering Corporation
Intercontinent Aircraft Corporation
Lockheed Aircraft Corporation
The Glenn L. Martin Company
North American Aviation, Inc.
Northrop Aircraft, Inc.
Republic Aviation Corporation
Stinson Aircraft Division, Vultee Aircraft, Inc.
Vega Aircraft Corporation
Vought-Sikorsky Aircraft Division, United Aircraft Corporation
Vultee Aircraft, Inc.

AIR TRANSPORTATION

American Airlines, Inc.
Northwest Airlines, Inc.
Pan American Airways System
Transcontinental & Western Air, Inc.
United Air Lines Transport Corporation

ALTIMETERS

Kollsman Instrument Division, Square D Company
Pioneer Instrument Division, Bendix Aviation Corporation

ALUMINUM

Aluminum Company of America

BATTERIES

The B. F. Goodrich Company

BEARINGS

Allison Division, General Motors Corp.
Norma-Hoffmann Bearings Corporation

BOOKS (TECHNICAL)

Bunhill Publications, Ltd.
The Macmillan Company
The Ronald Press Company

BOMB RACKS

Spriesch Tool & Mfg. Company

BOMBARDMENT PROTECTION

Ralph M. Kendall

CAMERAS & SUPPLIES

Fairchild Aviation Corporation

CAMOUFLAGE

Ralph M. Kendall

CARBURETORS

Bendix Products Division, Bendix Aviation Corporation
Chandler-Evans Corporation

CASTERS

Darnell Corporation, Ltd.

COLLECTOR RINGS

Edward G. Budd Manufacturing Company
Thompson Products, Inc.

COMPASSES

Bendix Radio Corporation
Fairchild Aviation Corporation
Kollsman Instrument Division, Square D Company
Pioneer Instrument Division, Bendix Aviation Corporation
Sperry Gyroscope Company
Weston Electrical Instrument Company

COMPOUNDS (CLEANING)

Oakite Products, Inc.

CONNECTORS (ELECTRICAL)

Cannon Electric Development Co.

CONTROLS & ASSEMBLIES

Automatic Electric Company
Breeze Corporations
Eclipse Aviation Division, Bendix Aviation Corporation
Pump Engineering Service Corporation
Spriesch Tool & Manufacturing Company
S. S. White Dental Mfg. Company
Sperry Gyroscope Company
Vega Aircraft Corporation

COOLERS (OIL)

Airesearch Manufacturing Company
Edward G. Budd Manufacturing Company
Fedders Manufacturing Company
Standard Aircraft Products, Inc.

CORD (SHOCK)

The B. F. Goodrich Company
United States Rubber Company

COWLS

Airplane Division (Buffalo Plants), Curtiss-Wright Corporation
Edward G. Budd Manufacturing Company
Vega Aircraft Corporation

DE-ICER EQUIPMENT

Eclipse Aviation Division, Bendix Aviation Corporation
The B. F. Goodrich Company
Pump Engineering Service Corporation

ELECTRICAL EQUIPMENT

Automatic Electric Company
Cannon Electric Development Co.
Ohmite Manufacturing Company
Square D Company, Regulator Division and Industrial Controller Division
Struthers Dunn, Inc.

ENGINEERS (CONSULTING)

Ralph M. Kendall

ENGINES

Allison Division, General Motors Corp.
Eclipse Aviation Division, Bendix Aviation Corporation
Guiberson Diesel Engine Company
Jacobs Aircraft Engine Company
Packard Motor Car Company
Pratt & Whitney Aircraft Division, United Aircraft Corporation
Ranger Aircraft Engines Division, Fairchild Engine and Airplane Corporation
Warner Aircraft Corporation
Wright Aeronautical Corporation

FABRICS

Wellington Sears Company

FASTENERS

Boots Aircraft Nut Corporation
Camloc Fastener Company
Eaton Manufacturing Company
Elastic Stop Nut Corporation
Shakeproof, Inc.
Thompson Products, Inc.
Tinnerman Products, Inc.
United Carr Fastener Corporation

FELT

American Felt Company